THE TELEGRAPHIC JOURNAL AND

Electrical Review.

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THE SCIENTIFIC ASSEMBLY IN MONTREAL.

THE Canadian meeting of the British Association has now disappeared into the realm of things of the past; but it will long remain a memorable event in the history of the colony, and a pleasurable recollection to those English, Canadian, and American scientists who took part therein. The actual scientific outcome of the remarkable migration from these shores of so many of our most eminent men may possibly be insignificant, but the meeting and its attendant incidents will, we doubt not, be found to have borne results which must effectually silence those who questioned the wisdom of the journey across the seas. Contact with the minds which have done so much to make England famous in the world of science cannot be without some effect upon the Canadian people, and we venture to predict that many a notable name in the future days of the rising young colony will be able to attribute its greatness to the interest aroused in intellectual pursuits by the visit to their land of the distinguished association from England. This, in itself, will be a result of no mean importance. We fully endorse the remarks of Lord Lansdowne, Governor-General of Canada, when, addressing the Association at its opening meeting, he stated:—"Such a departure from the usage which you have hitherto observed, though an inauguration, is certainly not inconsistent with the objects of the association or with the designs of its founders, for its earliest records contain the statement that it was instituted for the promotion of intercourse between those who cultivated science in different parts, not merely of the British Islands, but of the British Empire." Another point in Lord Lansdowne's address is not without its significance, though probably beyond our province to discuss; his Excellency alluded to the fact that that was the first meeting of the society for fifty years which had been held out of England, and then remarked that, remembering this, they felt that one more step had been taken towards the establishment of that close intimacy between the mother country and her offspring which all good citizens of the Empire were determined to promote. The motives we have indicated we hold to be quite sufficient justification of the new departure which was at first by some adversely criticised; and, confident that our anticipations will be realised, we trust the various English members will return from their most enjoyable trip, refreshed and stimulated both in mind and in body, to give us, for many years to come, fresh insight into the mysteries of science.

THE TELEPHONE IN SOUTH AUSTRALIA.

WE are indebted to the *South Australian Register*, whose special reporter recently visited the Adelaide Telephone Exchange for the following information respecting the progress of telephony in South Australia. The Postmaster-General (Mr. Todd), and his able assistant in this department (Mr. C. Unbehaun) have devoted close attention to the study of the telephone ever since its invention by Professor Bell.

In the year 1880 Mr. Todd submitted a memorandum to the Minister of Education, in which he recommended the Government to establish a telephone exchange; and in 1881 a Bill was introduced in the House of Assembly by the Hon. J. L. Parsons for the purpose of giving effect to the scheme Mr. Todd proposed. The Bill gave the Government the exclusive right to erect and maintain telephone lines in the colony, and it rapidly passed through both Houses of the Legislature, the only objection raised to it being based upon what has since proved to be an erroneous assumption that it would interfere with the success of the telegraphic system, and would not contribute anything to the revenue.

Mr. Todd selected the Blake transmitter, the Bell receiver in the form known as the "Ponycrown," and the "Swiss" telephone.

The Act was first brought into operation in 1882, when a number of private lines were laid down and leased, and the telephone exchange was not opened until May of last year. At that time the number of subscribers was only twenty-five, whereas the number at the present time is 263, of which 217 are connected with the Adelaide Exchange, and 46 with the Port Adelaide Exchange. In addition to this there are 156 private lines. This is very satisfactory progress, and, considering its age, the exchange will now bear favourable comparison with the exchanges in the other colonies.

The number of subscribers in the other colonies at the commencement of this year was as follows:—Melbourne 650, Ballarat 81, Sandhurst 37, Sydney 260, Dunedin 237, Auckland 151, Christchurch 125, and Wellington 60. In addition to the exchanges at Adelaide and Port Adelaide, the telegraph offices at the Exchange (Pirie Street), Rundle Street, Adelaide Railway Station, Unley, Norwood, North Adelaide, and Hindmarsh are connected, and the Semaphore and Largs Bay Railway Station are to be added. Branch exchanges are also to be established at the Semaphore and at Mount Lofty, and if the business increases as it has hitherto done further extensions will soon become necessary. There are about 700 sets of telephones now in use, and the greater proportion of these have been purchased of the Western Electric Telegraph Company of Chicago, whose instruments are considered to be superior to those manufactured in England.

The total length of wire erected is 983 miles, and the longest telephone lines are the following:—Government House to Marble Hill, 13 miles; McCulloch—Goolwa to Port Victor, 11 miles; Cave & Co. (S. A.) to Crafers, 10 miles. Mr. Cave joins his Port wire to the Crafers line, and the length is thus increased to 18 miles. The above does not include the railway telephone lines, the longest of which is from Kapunda to North-West Bend, 56 miles, and from Burra to Petersburg, 55 miles.

The charges made to subscribers are lower than those imposed by the postal authorities in England, and some special facilities are afforded, some of which do not pertain elsewhere. For instance, clause 14 of the regulations provides that chemists situated along any existing line of telegraph or telephone within a distance of five miles from a telephone exchange may be connected with such exchange on payment of a subscription of £12 per annum, on the understanding that persons will be allowed to consult any medical subscriber on payment of 6d. for every five minutes, or free of charge where the medical subscriber pays the additional £9 a year. The telephone must be available for purposes of medical consultation day and night; but a private fee

of 2s. may be charged during the night, or between the hours of 10 p.m. and 7 a.m. The number of communications per diem through the exchange is about 1,000, and there is room for almost unlimited extension, the capabilities of the machinery being dependent only on the number of attendants employed.

ON ELECTRIC LIGHTHOUSES.

By M. A. DE MERITENS.

(*Continued from page* 188.)

The electric lamp for lighthouses is that of M. Victor Serrin. Notwithstanding certain modifications which the use of much more energetic currents has rendered necessary, this lamp is still used in all lighthouses. It is my duty to point out to you the parts which have been modified in this apparatus as it proceeded from the hands of the inventor, and the reasons of these modifications. The alternating current has the property of heating the electro-magnet, in the spirals of which it passes, much more than does a continuous current. The heating is derived here from the iron core of the electro-magnet much more than from the copper wire which covers it and through which passes the current. The change of polarity of the core multiplied so often in a unit of time by the reversals of the current produces agitations—molecular shocks absolutely analogous to the vibrations which the dynamic theory of heat admits as the productive cause of heat itself. Hence comes the heat developed. With the use of very energetic currents the heating of the electro-magnet in the lighthouse lamp is such that it occasions the expansion of other parts enclosed in the apparatus, and interferes with the regularity of the working. M. A. Berjot has therefore substituted for the electro-magnet of the Serrin lamp four solenoids, two with thick wires placed in the circuit, and two with fine wires connected in derivation. The cores of the four solenoids are connected intimately with the movement of the parallelogram. The two first drawing from above downwards effect the withdrawal; the other two, acting in the opposite direction, raise the pan of the brake and allow the carbons to approach each other. Only a fraction of the current of the machine is sent into the solenoids, sufficient to supply them, and thus the production of heat is lessened. M. Berjot has also introduced into Serrin's parallelogram the suspension with spring plates, known as *Breguet's suspension*, thus suppressing all lateral play, whilst giving more flexibility to the vertical movement.

A steel pulley governs the drum forming the first movement of the regulating wheel-work, and is substituted for the "Gall chain" of Serrin's apparatus. A complete disc and pan of steel fixed upon the parallelogram by a spring plate fulfils the function of the star wheel and the stoppage finger. An air pump serves to deaden the oscillations derived from the inertia of the parts set in motion. A piece of refractory earthenware protects the stem of the upper carbon-holder against the thermic action of the arc.

This apparatus has given very good results; it is at work in several lighthouses, among others in that of Macquarie (New South Wales), where for more than two years it has given great satisfaction. But the requirements made increase in the same proportion as the means for satisfying them.

After the first lighthouse machines, producing 100 to 150 carcels, others were wanted giving 1,000 or 1,500, such as those of which we have just spoken. Generators are now required yielding 3,000, 6,000, and even 9,000 carcels.

The clever modifications introduced by M. Berjot have become, in their turn, insufficient. It became absolutely needful to remove every trace of heat from the interior of the apparatus, the foci of which became small volcanoes. This object has been effected as follows:—The action of the two solenoids with fine wire in Berjot's lamp has been rendered independent of that of the solenoids with coarse wire. The former act alone, by attraction, upon a horizontal lever fitted with a long vertical rod passing through the axis of suspension, and being prolonged below. This vertical rod supports, at its lower end, a steel projection, which can enter between the branches of the star wheel which forms the last movable part of the train of regulating wheel-work. When the carbons are at a distance from each other, the attraction of the fine wire solenoids is at its maximum. The long vertical rod abuts on a spring plate placed behind it, and sends a portion of the current into the two solenoids with coarse wire, which are also placed in derivation. These raise the lower carbon. At the moment of contact the four solenoids cease to act, as they no longer receive any portion of the current. The lower carbon, being no longer lifted, falls back, and the arc is established or the illumination is set up, all the current passing into the carbons. There is no more current in the lamp until the arc increases beyond the point desired and arranged for. Heating is therefore impossible, whatever may be the intensity of the focus.

This device is due to M. Le Baron, the engineer of my works. It completely solves the question of lighthouse lamps, and gives us the power to produce at will, with the same lamp, a light of from 100 to 9,000 carcels.

The author then enumerates the electric lighthouses now existing. These are—in France those of Planier, Dunkirk, Calais, La Hève, and Cayeux; in England, the Lizard, South Foreland, St. Catherine, with Macquarie in New South Wales. There is an electric lighthouse in the United States, one in Russia, one in Portugal, and one in Italy.

Next follows an account of Trinity House as the English authority for regulating lighthouses. M. de Meritens continues:—At the beginning of this paper I laid before you figures showing that we gain but little in the range of a lighthouse by augmenting the intensity of its focus. The denser the fog the less is the benefit. Still there is a benefit, and it is exactly in the densest fogs that it is most essential to see the lighthouse as far as possible. Whatever it costs we must try to arrive at it, and at least find out the smallest distance at which can be seen a lighthouse illuminated by the most enormous focus which it is possible to produce. With this view the Board of Trinity House instructed Sir James Douglas, their chief engineer, to undertake the necessary experiments at the South Foreland.

There have been constructed three provisional towers of the same height, which are on a line almost perpendicular to the length of the strait. Their lights can be seen from the sea to the north-east and the south-west. The tower most remote from the sea is lighted with mineral oil, by means of a new lamp. That in the middle is lighted with gas, and the one nearest the sea is fitted with the most powerful electric light which has hitherto been produced. This light can at pleasure be divided into three separate lights, one above another, and having each a luminous intensity double that of the lighthouses on the coasts of France.

There are at South Foreland three of the machines of M. de Meritens, each with 60 magnetised bundles and 120 bobbins. Two of these machines are fitted with a mechanical apparatus which enables them to be connected together, and consequently to utilise their currents, connected in quantity with the same lamp. On combining the currents in series two superposed lights may be supplied with the same conducting cable. The third machine sends its current into the third lamp.

The two connected machines are only temporarily at the South Foreland; they belong to the lighthouse of St. Catherine. Each of these machines furnishes a current of 250 ampères at the least, and of about 50 volts. Hence, at the focus of the lamp fed by the two connected machines there are 500 ampères. Sir James Douglas prefers for the service of the English lighthouses these large machines to the French pattern.

His reason is that we require on the English coasts different luminous intensities according to the atmosphere, which is very variable.

It is necessary to have at disposal either a medium light, or one of ten times the power, if found necessary.

Under these conditions, I have adapted to the new machines of the English lighthouses an apparatus which is peculiar to them. This apparatus renders it possible to use at pleasure only 1, 2, 3, or 4 of the rings of the machine, or to employ all five. The friction-brushes of the rings not in action are set aside by this apparatus, and do not touch the collecting rod. These great machines, the movable rings of which are 0·75 metre in diameter, make 600 revolutions per minute, and have the same electromotive force as ordinary machines at 900 revolutions. The rings of the latter are only 0·50 metres in diameter.

The lamps employed at the South Foreland have been constructed with the improvements devised by M. Le Baron. With a current of 500 ampères and about 50 volts, no elevation of temperature is perceived in the interior of the lamp. A great difficulty has been to procure carbons suitable for such intensities.

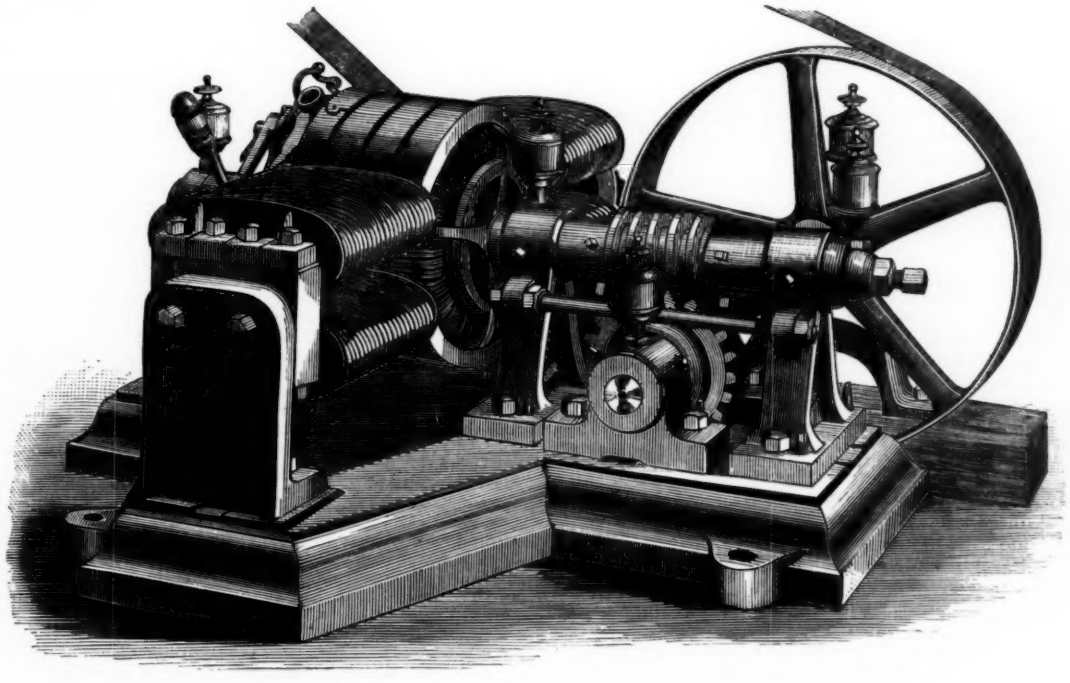
The carbons manufactured by M. E. Carré, which give complete satisfaction to the administration of the French lighthouses, and which I supply to all the foreign lighthouses the machines of which I have constructed, were incapable of solving the problem. An important expenditure of time is required for baking carbons even of 20 and 23 millimetres, and it is with difficulty that the baking is effected uniformly from the circumference to the centre. With carbons of 40 and 50 millimetres in diameter it would be impossible, and a homogeneous result would never be obtained. I have been obliged to have recourse to an artifice. Carbons of a very small section are perfectly homogeneous. I have ordered from M. E. Carré square carbons of 5 millimetres per side and I have connected them in bundles. It has thus become easy for me to have all the thicknesses necessary for my great lights.

The thickest carbon (among those exhibited by the author) is composed of 81 such square rods, each of 5 millimetres per side. It produces at the South Foreland a luminous intensity of 6,000 carcels without lenses, and of nearly 6,000,000 carcels in the optical apparatus. They threw at mid-day a ray of this light and a ray of the sun upon a surface of water, and no difference was perceptible. At the beginning of the experiments there occurred a curious incident. A village about ten miles from the lighthouse had been recently shaken by an earthquake. One night the enormous electric light was set in action without any warning. The country people rose up terrified, there was an alarm of fire, and an express was sent on horseback to the South Foreland to inquire if a volcano had not broken out. As the night was far from fine, the chief engineer of the Trinity House had thus the best proof of the full success of his experiment.—*Bulletin de la Société Internationale des Electriciens.*

THE DAFT ELECTRO-MOTOR.

MR. LEO DAFT, an American electrician, has been for some time engaged in reducing to practice the principles involved in the electrical transmission and distribution of power.

Although much has been said in the United States concerning the great value of Mr. Daft's electrical inventions, we fail to see, so far as his electro-motor is concerned, anything whatever which can be characterised as novel and original. The New York *Electrical World*, in its last issue, describes and illustrates both the generator and motor devised by Mr. Daft, the latter of which we reproduce.



The field-magnets are made after the Siemens plan, and are series-wound, but the coils of the field-magnets are divided so that there are two or more circuits around the core. By devices these are so related that they can be thrown into series or into multiple arc, or into other combination when there are more than two circuits, for the purpose of changing the strength of the magnetic field, to suit the electromotive force and strength of current supplied to the motors.

The armatures are modelled after the Gramme type, but their construction is improved in respect to the manner of mounting them on their shafts. Instead of wood, suitably insulated metallic spiders and connections are used for the purpose. Thus there is left a space within, around the shaft, through which air can circulate for ventilating and cooling purposes.

These motors are provided with gearing, so that the armatures may be run at high speed, but communicate to the driving pulley only a moderate rapidity of rotation. With that end in view, the armature shaft is lengthened on the end opposite the collector; two bearings are there provided, and between them there is a steel worm gearing with a phosphor-bronze wheel on the shaft carrying the driving pulley. This makes a good wearing combination. The bearings of the armature shaft are of phosphor-bronze, and an end plate and adjusting screw are provided to receive the thrust of the shaft due to the gearing. The whole makes a very practicable combination, taken in connection with the means of varying the field strength of the magnets of both generator and motor.

At No. 13, Spruce Street, in New York, there is one of Mr. Daft's electric generators, driven by steam power. On the opposite side of the street, at Nos. 32 and 34, in the buildings occupied by Messrs. Studwell, Sanger & Co., and by Messrs. Mulford, Cary & Conklin, are two of his motors, which receive electric current from the generator, and furnish the motive power for two elevators in those buildings. One of these has been in daily operation since January 10th, 1884, and the other since April, 10th, 1884, with great satisfaction. These motors are said to give far less trouble than did the steam appliances in use previous to that time.

One of these motors was also put commercially at work in the Newburgh Steam Mills for operating an elevator in September, 1883, It raises a load of 1,800 lbs. without difficulty. The Spruce Street elevators have a capacity of 2,000 lbs., with a speed of from 30 to 35 feet a minute.

Quoting from our contemporary, the elevator motors run continually during working hours. When not engaged in raising the elevators they run faster than when doing work. Consequently their counter electromotive force cuts down the current supplied to them to the point of supplying the energy necessary to overcome the friction of the motors and their gearing. The average speed when at work is 1,200 rotations per minute. The difference of potential at the terminals is about 90 volts. The current varies with the load, but averages about 25 ampères to each machine. The percentage of return is said to be 66 per cent.

The Daft Electric Light Company has one of its motors running at its factory, Greenville, N. J., to supply power to its wood-working machinery. It is said to give out 4½ horse-power, the current being sent through one mile of wire.

The generator appears to be, from the illustration shown in the journal from whence our information is derived, to all intents and purposes a Gramme machine.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—MONTREAL, 1884.

(*Continued from page* 185.)

ON A NEW VOLTMETER.

By CAPTAIN CARDEW, R.E.

IT is quite unnecessary at the present day to dilate on the extreme importance in electric lighting, especially by incandescence, of keeping the pressure or volts on the lamps constant within very small limits. The necessity for this must have forced itself on the notice of all who have had any experience of this lighting. However perfectly the dynamo may be compounded or the engine governed, it is very desirable that the engine driver should have an electric pressure gauge to which he can refer as readily as to his steam gauge. The instruments about to be described were originally designed for the use of engine drivers, and are adapted to the meanest capacity. At the same time they give perfectly trustworthy readings.

There are two ways of measuring the difference of potential or volts between the terminals of a dynamo or any other points in an electric circuit, which we may call the statical and dynamical methods. The former, or measurement of the force of attraction between bodies charged from the two points respectively, is too delicate for the purpose in view, and the latter, or measurement by means of a current produced by connecting these points by a conductor, was therefore adopted. Now, when a current is passing in a conductor it creates a magnetic field in its vicinity by which an effect can be produced on other bodies. The measurement of the current is usually made by observing this effect on another body. This method may fail from two causes:—

1. Other things may affect the body obscuring the effect of the current.

2. Owing to a change in the condition or position of the body, the effect of the current on it may be altered.

These were obvious objections to entrusting this method to an engine driver in a room full of dynamos and iron machinery, but the current energy produces another effect. It develops heat in the conductor, which causes an expansion of volume to take place in it. This effect of the current energy appeared likely to offer a solution of the difficulty.

The instrument now before you is the outcome of many experiments made with the view of utilising this effect for the exact measurement of the current passing, and thus of the difference of potential existing between the points to which the instrument is applied.

This instrument is extremely simple in principle and construction. It consists essentially of a very fine platinum silver wire, ·0025 in. in diameter, enclosed in a brass tube.

The difference of potential to be measured is applied at the ends of the wire, which is heated by the current passing through it. The wire expands on being heated, but is kept stretched by a spring or weight, and the expansion is indicated by suitable apparatus.

The heat produced in any conductor, not containing an electromotive force, by any difference of potential applied to the ends is equal to $\frac{V^2}{R}$ per unit of time, where V is the difference of potential in volts, and R the resistance in ohms. The resulting temperature of the conductor for any difference of potential depends on the temperature and the rate of motion of the particles of the surrounding medium. It will be seen from this that the absolute stretch of the wire, which would accurately measure its rise of temperature, would not be an accurate measure of the current passing through it, or of the volts producing that current. Even when no current was passing the instrument would not maintain an accurate zero, since alterations of atmospheric temperature would affect it.

These defects are obviated by the use of the brass tube enclosing the wire.

The coefficient of expansion of brass for temperature is sensibly the same as that of platinum silver.* Hence, so long as they are both at the same temperature, the zero is unaffected by any alteration of it, or the variations in length of the wire are compensated. When, however, a current is passed through the wire its temperature is raised above that of the surrounding tube, and a perfectly regular current of heat is established between the wire and the tube since all external draughts are prevented. It is therefore the difference of temperature between the wire and the tube that is measured, and this is necessarily constant for the same difference of potential, except for the fact that the resistance of the wire varies slightly with its temperature.

This variation in the resistance has the effect of causing the reading for any volts to be slightly higher on a cold day than it is on a warm one, but as the alloy of platinum and silver used only varies ·035 per cent. per degree Centigrade, this error is not worth consideration as long as the surrounding air is at an ordinary temperature.

The considerations guiding the choice of a wire for the purpose were as follows:—

1. It must absorb a minimum of energy, therefore the wire should be as fine as possible and of a high specific resistance.

2. It must follow all variations in the volts with extreme rapidity, and must therefore be formed of a metal of low specific heat, and must offer a large surface for its mass.

3. The material must not be liable to oxidation even at a high temperature.

4. The coefficient of variation of resistance for temperature must be very small.

5. Its elasticity and tensile strength must be high.

A fine platinum silver wire best answered these conditions.

The instruments are practically instantaneous in their indications and quite dead beat.

Having determined by these considerations the most suitable material and size of wire, the next point to determine was the number of volts that could safely be put on any length of it. With this view one foot of the wire was taken, and the number of volts required to make it just visibly red in a dark room determined to be 21. As the rise of temperature for any number of volts varies as v^2 it is evident that 10 volts would only raise 1 ft. to rather less than ¼ the amount required to redden it. Experience has shown that this rise does not permanently alter the wire.

The working maximum number of volts is therefore taken at 10 per foot. For 200 volts, therefore, 20 ft. of the wire is required, but this length need not necessarily be contained in the instrument, although it is advisable to use the same kind and size of wire throughout.

* More perfect compensation is obtained by making two-thirds of the tube of brass, and one third of iron or tinned iron.

The instruments are generally made to work to 120 volts, and a sufficient length of wire supplied in a metallic box to extend the readings to any required number of volts.

For ordinary purposes it is quite sufficient to extend the limits to which the instrument will measure by putting an incandescent lamp in circuit with it. Thus an instrument for 120 volts has a resistance of about 360 ohms, and if an Edison lamp be added it will easily read to 200 volts.

In order to save the instrument from fusion by excess of current a safety fuse is placed in the circuit. This consists of a short length of finer platinum silver or iridium platinum wire.

As regards the application of the instrument to alternating currents, the pressure which it will indicate with these is the equivalent useful pressure of difference of potential—that is to say, it indicates a difference of potential which, with a continuous current would, if applied to the same wire, do the same amount of work per unit of time. This is evidently what is required to be known for all industrial applications. Of course the absolute difference of potential with an alternating current is continually varying between certain positive and negative limits much higher than the industrial mean, passing in each period of variation through the value 0.

The instrument, however, while indicating the industrial mean follows the variations of pressure sufficiently to emit a musical note corresponding in pitch to the number of alternations per unit of time.

In the more portable instruments on this principle the extension of the wire is multiplied so as to give a reading over a large dial by delicate wheelwork. This necessarily introduces some complication and chance of error, although the force of the spring is sufficient to easily overcome the friction.

For a standard instrument, not intended to be carried about, it was worth while to eliminate this chance.

In considering this the use of a beam of light as an index naturally suggested itself. As the natural motion in this case was rectilinear, and not angular as in a reflecting galvanometer, it was obvious that the best arrangement was a kind of magic lantern by which a greatly magnified image of a portion of the wire should be projected on a screen.

Two very fine cross wires are fixed on the wire within the field of the lens, which, of course, appear in the magnified image on the screen. The distance between the images of these cross wires constitues the base line which is always kept of a certain length, so many feet or inches, by slightly moving the screen or instrument. When the volts are applied the cross hairs move down by the extension of the wires, their images, of course, move up, the upper one soon disappears, but the reading is taken from the lower one, and having once standardised the instrument with a certain base line we can at once obtain the volts corresponding to any movement of the lower image by reference to the curve. The instrument in this form then is one of elementary simplicity, and yet may be called scientific. Here is a rough arrangement to illustrate the principle. It consists of the tube with the wire down the centre terminating in a spring, the lens arranged with the wire and cross hairs in focus, the dark lantern, of course, separate from the tube to avoid error from the heat given off by it and the screen. The instrument has not been standardised but we will take readings on the portable instrument at the same time.

In order to make a direct reading instrument of this, that is to say measure off the volts at once, it is sufficient to mark them off from the curve of the instrument on a piece of stiff card or slip of wood of the exact length of the base line.

This form of instrument can be made moderately portable by attaching a camera body to the tube, the image of the wire being received on a ground-glass screen with a scale marked on it. In this case the tube should act as a support to the camera, as the wire can be pulled up as well as down.

The instrument can readily be made to register ordinary variations of electric pressure on mains by simply fixing a very small incandescent lamp—the size used for surgical purposes answers well—on the wire, so that the current through the wire passes also through the lamp and renders it luminous. These lamps are made to take a current of about one-fourth ampère, which gives a good extension to the wire, the maximum current it can safely take, being rather under one-third ampère. The image of the filament of the lamp, which in this case is nearly a straight line, is thrown by the lens on a sheet of paper sensitised by the bromide process, all other light being carefully excluded; so long as the volts remain constant the filament will simply produce a magnified image of itself, but any variation of the volts by causing the lamp to slightly shift its position will produce a vertical elongation of the mark.

After each night's work the paper can be developed, fixed, and examined, and the limits of variation of potential for the whole time obtained by simple measurement.

As the companies undertaking house-to-house lighting will be liable to fine if a certain limit of variation is at any time exceeded, registering instruments of this kind will become a necessity.

The only other form of this instrument which is worth mentioning as promising to have a distinct use, is a pocket form with tube not more than a foot long in which the readings are taken by observing the movement of the wire with a simple microscope. In this case the wire is not pulled by one end, but in the middle, a very slight actual extension being sufficient to produce a perceptible sag in a stretched wire. This idea was suggested to the inventor by Dr. Muirhead.

APPLICATION OF ELECTRICITY TO TRAMWAYS.

By M. HOLROYD SMITH.

LAST year when I had the pleasure of reading a paper before you on my new system of electric tramways, I ventured to express the hope that before twelve months had passed, "to be able to report progress," and I am happy to say that, notwithstanding the wearisome delay and time lost in fruitless negotiations, and the hundred-and-one difficulties within and without that have beset me, I am able to appear before you again and tell you of advance.

Practical men know well that there is a wide difference between a model and a full-sized machine, and when I decided to construct a full-sized tramcar and lay out a full-sized track, I found it necessary to make many alterations of detail, my chief difficulty being so to design my work as to facilitate construction and allow of compensation for that inaccuracy of workmanship which I have come to regard as inevitable.

In order to satisfy the directors of a tramway company of the practical nature of my system before disturbing their lines, I have laid, in a field near the works of Messrs. Smith, Baker & Co., Manchester, a track 110 yards long, 4 ft. 8½ in. gauge, and I have constructed a full-sized street tramcar to run thereon. My negotiations being with a company in a town where there are no steep gradients, and where the coefficient of friction of ordinary wheels would be sufficient for all tractive purposes, I thought it better to avoid the complication involved in employing a large central wheel with a broad surface specially designed for hilly districts, and with which I had mounted a gradient of one in sixteen.

But as the line in question was laid with all the curves unnecessarily quick, even those in the "pass-byes," I thought it expedient to employ differential gear, as illustrated at D, fig. 1,

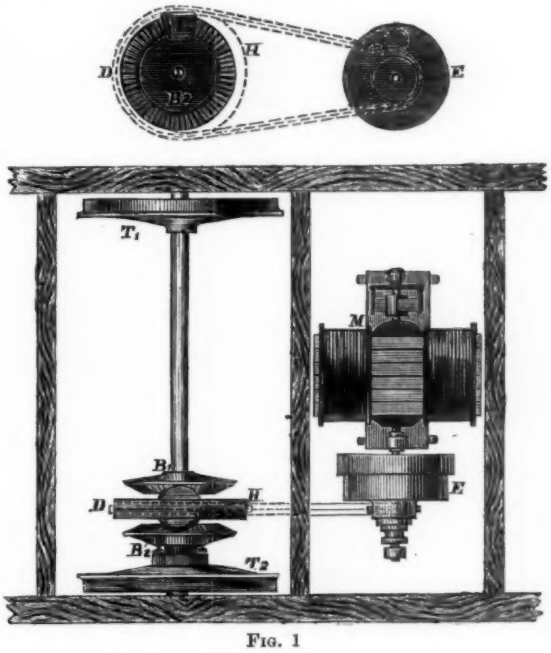


FIG. 1

which is a sketch-plan showing the mechanism employed. M is a Siemens electric-motor running at 650 revolutions per minute; E is a combination of box-gearing, frictional clutch and chain pinion, and from this pinion a steel chain passes round the chain-wheel, H, which is free to revolve upon the axle, and carries within it the differential pinion, gearing with the bevel-wheel, B^2, keyed upon the sleeve of the loose tram-wheel, T^2, and with the bevel-wheel, B^1, keyed upon the axle, to which the other tram-wheel, T^1, is attached. To the other tram wheels no gear is connected; one of them is fast to the axle, and the other runs loose, but to them the break is applied in the usual manner.

The electric current from the collector passes, by means of a copper wire, and a switch upon the dashboard of the car, and resistance coils placed under the seats to the motor, and from the motor by means of the adjustable clip (illustrated in diagram fig. 2) to the axles, and by them through the four wheels to the rails which form the return circuit.

I have designed many modifications of the track, but it is, perhaps, best at the present time to describe only that which I have in actual use, and it is illustrated in diagram fig. 3, which is a sectional and perspective view of the central channel. L is the surface of the road, and S, S are the sleepers, C, C are the chairs which hold the angle iron, A, A, forming the longitudinally slotted centre rail and the electric lead, which consists of two half-tubes of copper insulated from the chairs by the blocks, I, I. A special brass clamp, free to slide upon the tube, is employed for this purpose, and the same form of clamp serves to join the two ends of

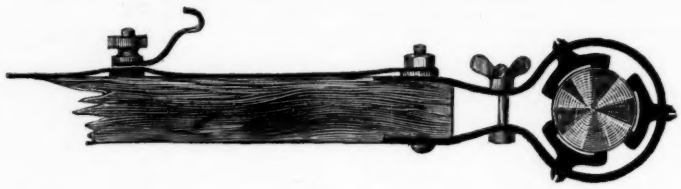


FIG. 2.

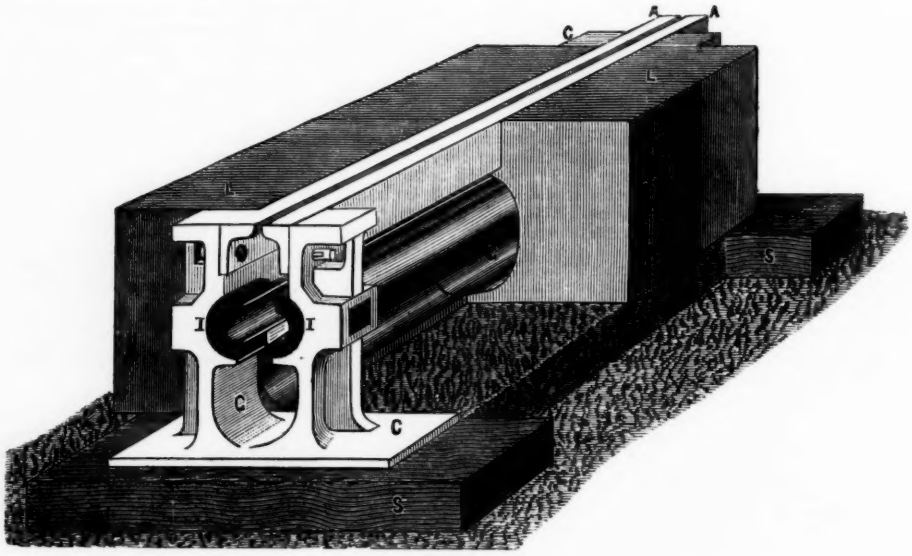


FIG. 3.

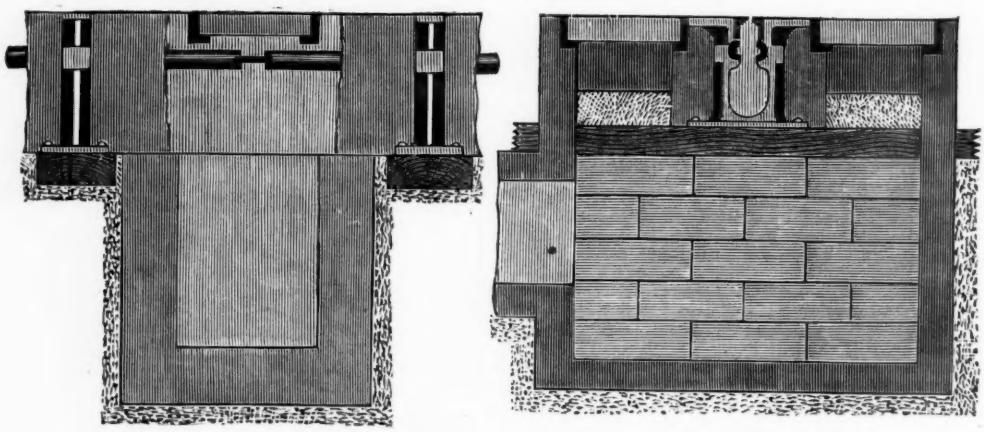


FIG. 4.

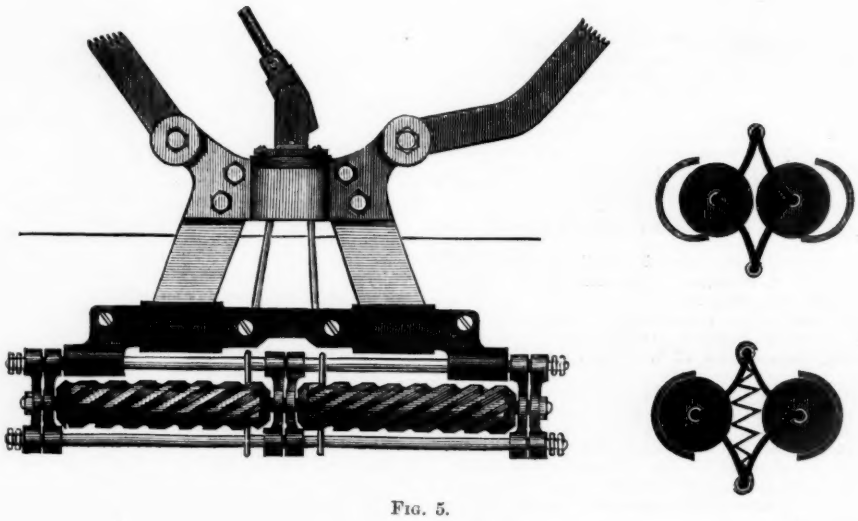


FIG. 5.

the copper tubes together and to make electric contact. Two half tubes instead of one slotted tube have been employed in order to leave a free passage for dirt or wet to fall through the slot in the centre rail to the drain space, G. Between chair and chair hewn granite or artificial stone is employed, formed, as shown in the drawing, to complete the surface of the road and to form a continuous channel or drain. In order that this drain may not become choked, at suitable intervals, in the length of the track, sump holes are formed as illustrated in diagram, fig. 4. These sump holes have a well for the accumulation of mud, and are also connected with the main street drain so that water can freely pass away. The hand-holes afford facility for easily removing the dirt.

In a complete track these hand-holes would occasionally be wider than shown here for the purpose of removing or fixing the collector, fig. 5, which consists of two sets of spirally fluted rollers free to revolve upon spindles, which are held by knuckle-joints drawn together by spiral springs; by this means the pressure of the rollers against the inside of the tube is constantly maintained, and should any obstruction occur in the tube the spiral flute causes it to revolve, thus automatically cleansing the tubes.

made that, by slackening the side-bolts, the steel plates can be drawn upwards and the collector itself withdrawn sideways through the handholes, one of the half-tubes being removed for the purpose.

Fig. 6 illustrates another arrangement that I have constructed, both of collector and method of collecting.

As before mentioned, the arrangement now described has been carried out in a field near the works of Messrs. Smith, Baker & Co., Cornbrook Telegraph Works, Manchester, and its working efficiency has been most satisfactory. After a week of rain and during drenching showers the car ran with the same speed and under the same control as when the ground was dry.

This I account for by the theory that when the rails are wet and the tubes moist the better contact made compensates for the slight leakage that may occur.

At the commencement of my paper I promised to confine myself to work done; I therefore abstain from describing various modifications of detail for the same purpose. But one method of supporting and insulating the conductor in the channel may be suggested by an illustration of the plan I adopted for a little pleasure line in the Winter Gardens, Blackpool.

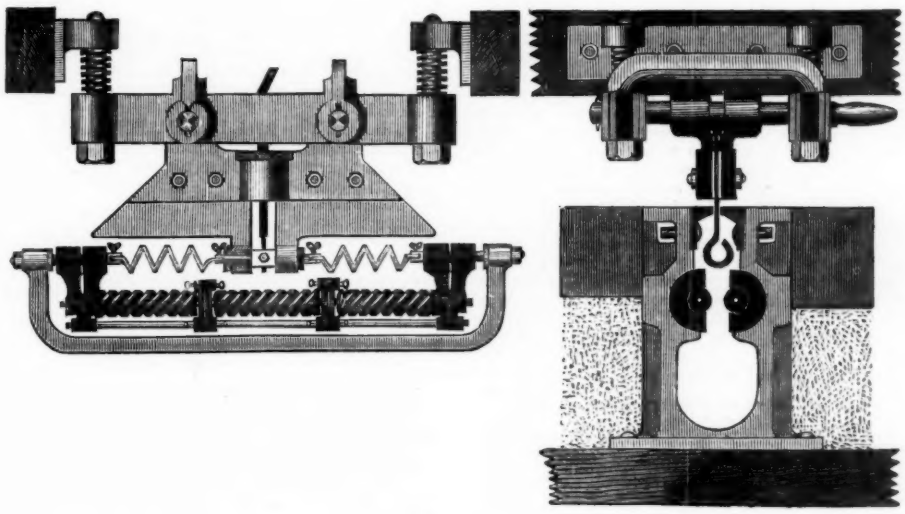


FIG. 6.

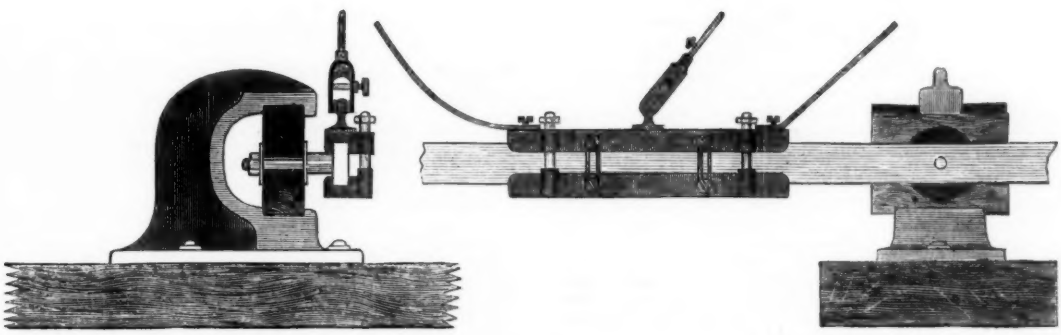


FIG. 7.

The collector is provided with two steel plates, which pass through the slit in the centre rail; the lower ends of these plates are clamped by the upper frame of the collector, insulating material being interposed, and the upper ends are held in two iron cheeks. Between these steel plates insulated copper strips are held, electrically connected with the collector and with the adjustable clip mounted upon the iron cheeks; this clip holds the terminal on the end of the wire (leading to the motor) firmly enough for use, the cheeks being also provided with studs for the attachment of leather straps hooked on to the frame-work of the car, one for the forward and one for backward movement of the collector. These straps are strong enough for the ordinary haulage of the collector, and for the removal of pebbles and dirt that may get into the slit, but should any absolute block occur then they break and the terminal is withdrawn from the clip; the electric contact being thereby broken the car stops, the obstruction can then be removed and the collector reconnected without damage and with little delay.

In order to secure continuity of the centre rail throughout the length of the track, and still provide for the removal of the collector at frequent intervals, the framework of the collector is so

Fig. 7. There the track being exclusively for the electric railway it was not necessary to provide a centre channel; the conductor has therefore been placed in the centre of the track, and consists of bar iron 1¼ in. by ¼ in., and is held vertically by means of studs rivetted into the side; these studs pass through porcelain insulators, and by means of wooden clamps, and wedges are held in the iron chairs which rest upon the sleepers. The iron conductors were placed vertically to facilitate bending round the sharp curves which were unavoidable on this line.

The collector consists of two metal slippers held together by springs, attached to the car by straps and electrically connected to the motor by clips in the same manner as the one employed in Manchester.

I am glad to say that, notwithstanding the curves with a radius of 55 feet and gradients of 1 in 57, this lines is also a practical success.

As I have not yet put into practice my proposed methods of dealing with points and crossings, and providing for long distances and many cars on the same line, I withhold description for a future occasion.

ON A GYROSTATIC WORKING MODEL OF THE MAGNETIC COMPASS.

Read by Sir WILLIAM THOMSON before the British Association, August 28th, 1884.

IN my communication to the British Association at Southport,* I explained several methods for overcoming the difficulties which had rendered nugatory, I believe, all previous attempts to realise Foucault's beautiful idea of discovering with perfect definiteness the earth's rotational motion by means of the gyroscope. One of these, which I had actually myself put in practice with partially satisfactory results, was a

GYROSTATIC BALANCE FOR MEASURING THE VERTICAL COMPONENT OF THE EARTH'S ROTATION.

It consisted of one of my gyrostats supported on knife edges attached to its containing case, with their line perpendicular to the axis of the interior flywheel and above the centre of gravity of the flywheel and framework by an exceedingly small height, when the framework is held with the axis of the flywheel and the line of knife edges both horizontal, and the knife edges downwards in proper position for performing their function. The apparatus, when supported on its knife edges with the flywheel not spinning, may be dealt with as the beam of an ordinary balance. Let now the framework bear two small knife edges, or knife-edged holes, like those of the beam of an ordinary balance, giving bearing points for weights in a line, cutting the line of the knife edges as nearly as possible, and of course (unless there is reason to the contrary in the shape of the framework) approximately perpendicular to this line, and, for convenience of putting on and off weights, hang, as in an ordinary balance, two very light pans by hooks on these edges in the usual way. Now, with the flywheel not running, adjust by weights in the pans if necessary, so that the framework rests in equilibrium in a certain marked position, with the axis of rotation inclined slightly to the horizontal in order that the axis of the flywheel, whether spinning or at rest, may always slip down so as to press on one and not on the other of the two end plates belonging to its two ends. Now, unhook the pans and take away the gyrostat and spin it; replace it on its knife edges, hang on the two pans, and find the weight required to balance it in the marked position with the flywheel now rotating rapidly. This weight, by an obvious formula which was placed before the section at Southport, gives an accurate measure of the vertical component of the earth's rotation.†

GYROSTATIC MODEL OF THE DIPPING NEEDLE.

I also showed at Southport that the gyrostatic balance described above, if modified by fixing the knife edges, with their line passing as accurately as possible through the centre of gravity of the flywheel and framework, and with the faces of the knives so placed that they shall perform their function properly when the axis of the flywheel is parallel to the earth's axis of rotation, and the rotation of the flywheel in the same direction as the earth's, will act just as does an ordinary magnetic dipping needle; but showing latitude instead of dip, and dipping the south end of the axis downwards instead of the end that is towards the north as does the magnetic dipping needle. Thus, if the bearing of the knife edges be placed east and west, the gyrostat will balance with its axis parallel to the earth's axis, and therefore dipping with its south end downwards in northern latitudes and its north end downwards in southern latitudes. If displaced from this position and left to itself, it will oscillate according to precisely the same law as that by which the magnetic needle oscillates.

If the bearings be turned round in azimuth the position of equilibrium will follow the same law as does that of a magnetic dipping needle similarly dealt with. Thus, if the line of knife edges be north and south, the gyrostat will balance with the axis of the flywheel vertical, and if displaced from this position will oscillate still according to the same law; but with directive couple equal to the sine of the latitude into the directive couple experienced when the line of knife edges is east and west. Thus this piece of apparatus gives us the means of definitely measuring the direction of the earth's rotation, and the angular velocity of the rotation.

These experiments will, I believe, be very easily performed, although I have not myself hitherto found time to try them.

GYROSTATIC MODEL OF A MAGNETIC COMPASS.

At Southport I showed that a gyrostat supported frictionlessly on a fixed vertical axis, with the axis of the flywheel horizontal or nearly so, will act just as does the magnetic compass, but with reference to "astronomical north" (that is to say, rotational north) instead of "magnetic north." I also showed a method of mounting a gyrostat so as to leave it free to turn round a truly vertical axis, impeded by so little of frictional influence as not to prevent the realisation of the idea. The method, however, promised to be somewhat troublesome, and I have since found that the object of producing a gyrostatic model of the magnetic compass may, with a very remarkable dynamical modification, be much more simply attained by merely suspending the gyrostat by a very long fine wire or even by floating it with sufficient stability on a properly planned floater. To investigate the theory of this arrangement let us first suppose a gyrostat with the axis of its flywheel horizontal, to be hung by a very fine wire attached to its framework at a point, as far as can conveniently be arranged for, above the centre of gravity of flywheel and framework, and let the upper end of the wire be attached to a torsion head, capable of being turned round a fixed vertical axis as in a Coulomb's torsion balance. First, for simplicity, let us suppose the earth to be not rotating. The flywheel being set into rapid rotation, let the gyrostat be hung by the wire, and after being steadied as carefully as possible by hand, let it be left to itself. If it be observed to commence turning azimuthally in either direction, check this motion by the torsion head; that is to say, turn the torsion head gently in a direction opposite to the observed azimuthal motion until this motion ceases. Then do nothing to the torsion head, and observe if a reverse azimuthal motion supervenes. If it does, check this motion also by opposing it by torsion, but more gently than before. Go on until when the torsion head is left untouched the gyrostat remains at rest. The process gone through will have been undistinguishable from what would have had to be performed if, instead of the gyrostat with its rotating flywheel, a rigid body of the same weight, but with much greater moment of inertia about the vertical axis, had been in its place. The formula for the augmented moment of inertia is as follows. Denote by—

W, the whole suspended weight of flywheel and framework,

K, the radius of gyration round the vertical through the centre of gravity of the whole mass regarded for a moment as one rigid body,

w, the mass of the flywheel,

k, the radius of gyration of the flywheel,

a, the distance of the point of attachment of the wire above the centre of gravity of flywheel and framework,

g, the force of gravity on unit mass,

ω, the angular velocity of the flywheel; the virtual moment of inertia round a vertical axis is

$$W K^2 \left(1 + \frac{w^2 k^4 \omega^2}{W^2 K^2 a g}\right) \qquad (1)$$

The proof is very easy. Here it is. Denote by—

ϕ, the angle between a fixed vertical plane and the vertical plane containing the axis of the flywheel at any time, t.

θ, the angle (supposed to be infinitely small and in the plane of ϕ) at which the line, a, is inclined to the vertical at time, t.

H, the moment of the torque round the vertical axis exerted by the bearing wire on the suspended flywheel and framework.

By the law of generation of moment of momentum round an axis perpendicular to the axis of rotation requisite to turn the axis of rotation with an angular velocity, $\frac{d\phi}{dt}$, we have

$$w k^2 \omega \frac{d\phi}{dt} = g W a \theta \qquad (2)$$

because $g W a \theta$ is the moment of the couple in the vertical plane through the axis by which the angular motion, $\frac{d\phi}{dt}$, in the horizontal plane is produced. Again by the same principle of generation of moment of momentum taken in connection with the elementary principle of acceleration of angular velocity, we have

$$w k^2 \omega \frac{d\theta}{dt} + W K^2 \frac{d^2\phi}{dt^2} = H \qquad (3)$$

Eliminating θ between these equations we find

$$\left(\frac{w^2 k^4 \omega^2}{g W a} + W K^2\right) \frac{d^2\phi}{dt^2} = H \qquad (4)$$

which proves that the action of H in generating azimuthal motion is the same as it would be if a single rigid body of moment of inertia given by the formula (1), as said above, were substituted for the gyrostat.

Now to realise the gyrostatic model compass; arrange a gyrostat according to the preceding description with a very fine steel bearing wire, not less than 5 or 10 metres long (the longer the better; the loftiest sufficiently sheltered enclosure conveniently available should be chosen for the experiment). Proceed precisely as above to bring the gyrostat to rest by aid of the torsion head, attached to a beam of the roof or other convenient support sharing the earth's actual rotation. Suppose for a moment the locality of the experiment to be either the North or South pole, the operation to be performed to bring the gyrostat to rest will not be discoverably different from what it was, as we first imagined it when the earth was supposed to be not rotating. The only difference will be, that when the gyrostat hangs at rest relatively to the earth, θ will have a very small constant value; so small that the inclination of a to the vertical will be quite imperceptible, unless a were made so exceedingly small that the arrangement should give the result, to discover which was the object of the gyrostatic model balance described above, that is to say, to discover the vertical component of the earth's rotation. In reality we have made a as large as we conveniently can; and its inclination to the vertical will therefore be very small, when the moment of the tension of the wire round a horizontal axis perpendicular to the axis of

* No report of this communication has, so far as I know, hitherto appeared in print.

† The formula is

$$g w = \frac{1}{a} \cdot W k^2 \omega \gamma \sin l;$$

where w denotes the balancing weight; $g w$ the force of gravity upon it; a the arm on which this force acts; W the weight of the flywheel; k its radius of gyration; ω its angular velocity; γ the earth's angular velocity; and l the latitude of the place.

rotation of the flywheel is just sufficient to cause the axis of the flywheel to turn round with the earth.

Let now the locality be anywhere except at the North or South pole; and now, instead of bringing the gyrostat to rest at random in any position, bring it to rest by successive trials in a position in which, judging by the torsion head and the position of the gyrostat, we see that there is no torsion of the wire. In this position the axis of the gyrostat will be in the North and South line, and, the equilibrium being stable, the direction of rotation of the flywheel must be the same as that of the component rotation of the earth round the North and South horizontal line, unless (which is a case to be avoided in practice) the torsional rigidity of the wire is so great as to convert into stability, the instability which, with zero torsional rigidity, the rotational influence would produce, in respect to the equilibrium of the gyrostat with its axis reversed from the position of gyrostatic stability. It may be remarked, however, that even though the torsional rigidity were so great that there were two stable positions with no twist, the position of gyrostatic unstable equilibrium made stable by torsion would not be that arrived at: the position of stable gyrostatic equilibrium, rendered more stable by torsion, would be the position arrived at, by the natural process of turning the torsion head always in the direction of finding by trial a position of stable equilibrium with the wire untwisted by manipulation of the torsion head.

Now by manipulating the torsion head bring the gyrostat into equilibrium with its axis inclined at any angle, ϕ, to that position in which the bearing wire is untwisted; it will be found that the torque required to balance it in any oblique position will be proportional to sin, ϕ.

The chief difficulty in realising this description results from the great augmentation of the virtual moment of inertia, represented by the formula (1) above. The paper at present communicated to the section contains calculations on this subject, which throw light on many of the practical difficulties hitherto felt in any method of carrying out gyrostatic investigation of the earth's rotation, and which have led the author to fall back upon the method described by him at Southport, of which the essential characteristic is to constrain the frame of the gyrostat in such a manner as to leave it just one degree of freedom to move. The paper concludes with the description of a simplified manner of realising this condition for a gyrostatic compass—that is to say, a gyrostat free to move in a plane either rigorously or very approximately horizontal.

INTERNATIONAL HEALTH EXHIBITION.

REPORT ON ELECTRIC LIGHTING. BY PROF. GEORGE FORBES.

THE following is the first of a series of reports on the exhibition which it is proposed to publish in the *Journal of the Society of Arts*:—

The electric light at the Health Exhibition this year resembles very much that of last year at the Fisheries Exhibition in the same place. But to the critical eye there is a vast improvement. Last year a gigantic system was installed in haste, and there was not the means to estimate properly the extent to which the lighting would be carried. The experience then gained has gone far to smooth away the preliminary difficulties. The engine-shed has been enlarged, and the plant laid down according to a more intelligible scheme, and all the arrangements have a more systematic basis. The result is correspondingly satisfactory, and serves as the best connecting link between the isolated installations, which have hitherto been most common, and the centralised stations for large supply, which it is expected will soon be generally demanded. The most evident improvement is in the general arrangement of the engine-shed; but experience has also done much in guiding many companies to sounder views as to the dimensions of cables and other all-important details.

To begin with the engine-shed, steam-power is supplied chiefly by Davey-Paxman engines, three of these engines being employed to drive two long countershafts in one line; these are 60 feet and 45 feet in length respectively. From these a vast number of dynamos of various kinds are driven. There are also three special engines by the same makers working the dynamos of the Hammond Company, the Gülcher Company, and the Jablochkoff Company respectively. A Hodgson rotary engine and a "Tower" spherical engine are also at work, each upon a "Victoria" dynamo of the Brush Company.

A gas engine is also shown close by, driving another "Victoria" dynamo, to illustrate Mr. Dowson's system of generating gas for the purposes of motive power.

One of Lautensach and Bittner's gigantic thermopiles has also been placed in the engine-shed, but it does not seem to have been put in operation up to the present date.

Nearly the whole length of the building is occupied on one side by two large Davey-Paxman pairs of horizontal engines, and the six boilers required for this duty. These boilers also supply steam to the two rotary engines mentioned above.

These six boilers are all connected together. One main water-pipe runs along the whole length of the six, and the pumps are so connected, that if one fails, the others act and supply through the main. The pumps are by Mumford, of Colchester. There is a throttle-valve attached for the feed of each boiler. Each boiler has an independent safety-valve and stop-valve. The exhaust steam is carried away by the funnels of these boilers. The steam pipes to the two engines are connected with all the boilers.

Each of the two large engines indicate about 350 horse-power. The one which drives the 60-feet countershaft has a 19-inch cylinder and 32-inch stroke. It is mounted on girders instead of being upon a solid bed-plate. This is for convenience of export. The cylinders are connected to the girders by strong brackets, which give great rigidity. The main valve is in a separate case to the cut-off valve, and this involves the use of less pressure to move the main valve. The cut-off can be varied from 0 up to ¾. There is a cylinder on each side of the driving wheel, and one governor acts upon both. The governor is supplied with a spring, to vary the action of gravity, so that the speed may be increased. It is not driven by belts, but by toothed-wheel gearing. The efficiency of one of these governors was shown on a recent occasion here, when the 21-inch link leather belt broke when in full action, and the speed changed by barely a revolution a minute. Schönheyder's lubricator is used in this engine. There are two driving pulleys 12 feet diameter and 16 inches wide. The engine runs at 72 revolutions, and the pressure of steam has been 85 lbs. These driving wheels have each a 15-inch belt of linked leather driving a pair of 39-inch pulleys on the long countershaft, the distance between centres being 31 feet.

The second large double-cylinder engine drives a countershaft of 45 feet length. This engine resembles the first, but it has an 18¼-inch cylinder, with a 32-inch stroke. It has only one driving pulley, 12 feet diameter and 24 inches wide. The 19-inch linked leather belt which broke on this work has been replaced by another, 24-inch wide.

The third engine, of Messrs. Davey and Paxman, is a fixed horizontal compound engine, in use by the Hammond Company to drive the Ferranti 1,000-lighter alternate current machine, a 40-lighter Brush machine, and a Ferranti 200-incandescent lighter. It has a single gridiron valve and a cut-off valve. The exhaust valve is in the same case as the slide valve of the low-pressure cylinder; the latter cuts off at half-stroke. The high-pressure cylinder has a diameter of piston of 15 inches and a stroke of 2 feet, and the low-pressure 22 inches with a 2-feet stroke. This engine has indicated up to 220 horse-power, with a pressure of 120 lbs. It drives two pulleys, one 10 feet diameter and 16 inches wide for the large Ferranti machine; the other a smaller one for the other two dynamos. This engine is fed by two boilers called a 50 and a 16 horse-power boiler respectively. These have each a donkey pump and injector.

The fourth engine is a compound one used for seven Gülcher dynamos. It resembles the last, but the diameters of the high and low-pressure cylinders are 12¼ and 20¼ inches, and the stroke 2 feet. It runs at 100 revolutions. With its attached boiler it can indicate 130 horse-power. The driving wheel is 8 feet 6 inches by 16 inches.

Another semi-fixed compound engine on the top of its boiler works the Jablochkoff dynamos. It has no special features of interest.

The first large engine described is assisted in driving the principal countershaft by a 25 horse-power engine, working, it is said, up to 100 horse-power. Altogether over 1,100 horse-power is developed in the engine-shed.

The main countershaft, 60 feet long, drives two secondary countershafts, one of them driving six Gramme machines of the British Electric Light Company, viz., two A's, one D, and three E's; the other driving 10 double Edison machines. It also drives the following dynamos direct:—One Bürgin, four Pilsen-Joel, one Siemens alternate current with exciter (small), and two Paterson and Cooper's "Phœnix" machines, all these on one side of the countershaft, and on the other side one huge Siemens direct machine for 420 ampères and 80 volts, a Clerc machine with Siemens exciter (for the "Sun" lamps), two large low resistance Siemens alternate current machines with exciter, and another Siemens direct current dynamo. An Elphinstone and Vincent 400 lighter machine is also in place and at work.

The second countershaft, 45 feet long, drives three Hochhausen dynamos, one Brush (23 arcs), one Oppermann with exciter, and one Gerard.

A great deal of interest attaches to the large machine exhibited by the Hammond Company. This is a 1,000 incandescent lamp alternate current machine by Ferranti. It resembles his well-known type of machine in many respects, but is conspicuous for the perfecting of details of construction, and for some novelties which are introduced. It is fed by a large quantity of Siemens direct current dynamos, attached to the same shaft as the alternate current machine. The shaft has a large bearing on each side of the Ferranti armature, of the flywheel, and of the Siemens armature, and has, in addition, a thrust bearing. These bearings are lubricated under pressure, the oil being collected in a reservoir, filtered, and pumped up to a supply reservoir. In the other types of Ferranti machine it has been found that, to prevent abrasion, the collecting rings must be oiled, and the resistance thus introduced is in many cases equal to the total resistance of the armature. In the present type of machine the terminal wires are attached to rings on the shaft which rotate within hollow rings, the intermediate space being filled with mercury to complete the electrical contact. This arrangement seems to work admirably. This device was patented by me in 1883. It has been said that the direct and alternate machines are on the same shaft. This is not strictly so, for the shaft of the Siemens machine is driven from that of the Ferranti machine through a leather ring clamped to each of the shafts.

The Siemens machine gives 30 ampères and 120 volts, and works through the two sets of 24 Ferranti field-magnets, each set of 24 being connected in parallel. The Ferranti machine gives 400 volts at 600 revolutions. It supplies Woodhouse and Rawson lamps in the Aquarium refreshment bar and the dining-room in the conservatory.

Another large machine deserving special attention is the Siemens machine, exhibited by the water companies. It is called a B 2 dynamo. It is designed to give 420 ampères current, with 80 volts electromotive force, and is used for the fountain illuminations. On the armatures there are ribs of copper from end to end, held bound by strong metal bands enclosing them. These bands have their greatest width radial, to prevent local currents being developed, and are in pairs; and two pairs go to each terminal commutator. There are about 20 arms to the commutator. There are two pairs of brushes, each pair being side by side. The width of each brush is 4 inches. The position of the brushes is adjusted by a worm-wheel. The machine is compound wound, the series winding goes through the four arms of the field-magnets in parallel, and is of wire about ¼ inch diameter; the shunt winding goes round all four arms in succession, and is of No. 12 wire. The mechanical and constructive details of this machine are worthy of close inspection.

A machine shown by the Brush Company shows the enormous improvement which can be introduced by recognising, and so dispensing with, the local currents in the mass of iron constituting the armature. In this machine the armature is built upon a coil of hoop-iron, with H pieces let in during the winding to support the coils. A very great gain is said to have been obtained by this alteration.

The Hopkinson-Edison type of machine, manufactured by the Edison Company at New York, is exhibited by the Edison-Swan Company.

Of other machines mention may be made of the cheap classes of direct current and alternate current machines shown by Oppermann. The Gerard Company also show some small and cheap machines; among these is a very small compact laboratory machine, suitable to work with a treadle, which works four incandescent lamps.

The Victoria dynamos are on the model of the Schuckert machines, which, as turned out at Nürnberg, have acquired so high a reputation. In the Victoria, however, there are four poles, and the resulting pairs of coils on the armature are in parallel, so that there are only two brushes.

The Gramme, Hochhausen, Gülcher, Jablochkoff, Bürgin, Phœnix, and other machines, require no special notice here.

In the Consolidated Company's exhibit their secondary batteries are charged by a compact Parker-Elwell machine, with an 8-inch armature, giving 25 to 30 ampères and 130 volts; when run for a short time it can give 60 ampères without injury.

Having thus passed in review the dynamos at the Exhibition, it becomes a matter of interest to learn the size of cables used by different firms, and the current carried by them. In the following table the name of the company or firm, or other distinguishing mark, is given in the first column. The number of cables in parallel, or sections, is given in the second. The size of wire is in the third, thus 7/16 means seven wires of No. 16 in a cable. The current in ampères fills the fourth, and the fifth gives the ampères in volts:—

SYSTEM.	No. of Sections.	B.W.G. No.	Ampères.	Volts.
Siemens { main	1	19/16	160	76
Siemens { return	4	7/16	40	304
„ Swan	3	19/16	142	200
Bowman	1	14/16	9	350
Lea	1	14/16	22	260
Gramme-Brockie	1	14/16	12	400
Brush (part)	1	14/16	11	1,200
„ (part)	1	7/16		
Brush-Hammond (part) ...	...	14/16	11	2,000
„ „ (part) ...	...	7/16		
Pilsen-Joel	3	7/18	9	600
Gülcher	2	9/12	200	65
Hochhausen	1	7/18	12	1,645
Clerc's Sun Lamp (part) ...	1	7/20	9	500
„ „ (part) ...	1	7/16		
Hochhausen (mast) ...	1	14/16	20	250
Edison-Swan	1	3/4	630	110
Oppermann	1	19/14	53	200
Victoria (driven by Tower engine)	1	19/16	70	160
Sweden-Gatehouse ...	3	19/16	220	88
Ferranti	1	19/12	180	250
„	1	14/16	20	250

The total illumination is over 5,000 incandescent lamps, besides some 300 arc lamps. It is worthy of remark that Sir F. Bolton's fountain display uses up from 120 to 180 horse-power in the illuminations. As this Exhibition is to a great extent illustrative of what can be done on a large scale, the nature of the lighting is worthy of record. The following facts have accordingly been compiled for the purpose.

ARC LIGHTING.

The small corridor and the south promenade and vegetarian room are lighted by 11 Ball lamps with 1 Ball dynamo; the electric machinery room by 6 Werner and 6 Cardew lamps, fed by 1 Brush machine; the west corridor and the south annexe by 8 Clark-Bowman lamps with 1 Phœnix dynamo; Old London by 5 Lea lamps with 1 Gramme dynamo; the south central avenue and part of the east and west central gallery are lighted by 60 Jablochkoff candles with 3 machines, and there is a fourth spare one; in the west central gallery, 7 Brockie lamps and 1 Gramme dynamo; west and east annexes, 23 Brush lamps and 1 dynamo; east corridor, west and east quadrants, east arcade, and Du-Val dining room, 40 lamps and 1 Brush dynamo by the Hammond Company; west gallery, 39 Pilsen lamps, 3 Schuckert dynamos; central gallery, 29 lamps and 1 machine by Hochhausen; central fountain by 1 lamp and machine by Crompton, 10 lamps and 1 machine by Clerc, the latter being also distributed in the cascades and water pavilion garden. The Clerc machine is designed for three circuits of 10 lamps each. The Queen's Gate entrance has a Fox lamp and Oppermann machine; the masthead has 6 lamps on 1 machine by Hochhausen, and the conservatory has 4 lamps on 1 machine by Siemens.

INCANDESCENT LIGHTING.

Ten Edison machines light the following spaces:—Entrance vestibule, 23 Swan lamps and 107 Edison lamps; the arts gallery, 172 Swan and 122 Edison; Bertram and Roberts's dining rooms, 64 Swan and 264 Edison; cheap dining room, 31 Swan and 115 Edison; literary superintendent's room, 20 Edison. The south gallery, 2 Siemens alternate machines with 2 exciters—1,063 Swan lamps; dairies, 2 Gülcher machines, 370 Crookes lamps; Old London, 1 Gramme and exciter, and 30 lamps by Mackie; east central gallery, 340 Gatehouse lamps and 1 Elphinstone Vincent dynamo; water company pavilion, 1 Oppermann alternate current machine with exciter, and 234 Woodhouse and Rawson lamps; Prince of Wales pavilion, 1 Siemens with exciter, 180 Swan lamps, and 1 Siemens with exciter to 40 Woodhouse and Rawson 25 volt and 10 candle-power, besides 10 of 50 volts and 20 candle-power; the aquarium, west arcade, and west dining rooms and tea rooms, 1 Ferranti alternate current dynamo with Siemens exciter, and 909 Woodhouse and Rawson lamps; refreshment bar, 1 Phœnix dynamo and 40 half Bernstein lamps of 25 candle-power; cocoa tavern, 1 Victoria dynamo, and 100 Victoria lamps of 100 volts and 20 candles; Chinese restaurant, 204 Crookes 50 volt lamps, which with 300 more are fed by 6 Gülcher machines; Indian court, 38 Bernstein lamps on a Hochhausen machine—19 of these are series on two parallels; Doulton's pavilion has 24 Gerard lamps of 50 candles on 2 Gerard machines.

The only secondary batteries in regular action are those of the Consolidated Company in the machinery in motion gallery. The plates are made of corrugated strips of lead coiled into a disc and pressed into a square form.

Twice the lighting has failed up to this date (August 14th). Once a driving-belt gave way, and once a boiler-feeding valve stuck, and the boilers being all connected together the steam escaped. It may be said that the boilers being connected in parallel, and one of them short circuiting the mains, the whole of them were burnt up or run dry.

Mr. W. D. Gooch has superintended all the arrangements. Everything seems to be as well arranged as is possible with so great a mixture of systems in use. This is the most extensive application of electric lighting hitherto seen in this country.

THE McTIGHE GENERATOR.

BY a long and costly series of experiments the McTighe Electric Light Company, of Pittsburgh, has demonstrated that for practical purposes the "ring armature," when properly constructed, exhibits the highest efficiency.

The armature is formed of a number of gapped soft-iron rings, secured together and to the shaft by a number of through bolts, which pass through the arms of a bronze spider keyed on to the shaft. This construction, says the New York *Electrical Review*, is thoroughly mechanical, and the rings can be displaced only by the shearing of the bolts, which is impossible. Hence the armature can be run at an extraordinary rate of speed (if necessary) with perfect safety. The shaft is steel, and runs in long bearings of the best bronze. The gaps in the iron rings enable one to wind the armature coils in a mould, and afterward slip them through the gaps on to the rings. The gaps are then arranged out of line so that all the coils are securely held on the ring.

By winding the coils in this manner two very important advantages are secured:—

First. The coils can be perfectly insulated by winding them all over with a durable insulating tape, and before each coil is put on the rings its insulation is thoroughly tested.

Second. The coils being wound in a mould or "former," they are all exactly alike in length of wire, number of convolutions and electrical resistance; hence an armature composed of them will be in perfect electrical balance in all its positions, a fact which bears an important relation to the steadiness of the light.

By an entirely novel arrangement of the field-magnets and pole pieces the armature is completely surrounded by the solid protection of the metal framing, and is not liable to injury from the exterior; while this is true, it is also true that in five minutes the armature can be taken out, or one or both of the field-magnets removed without disturbing the remaining parts.

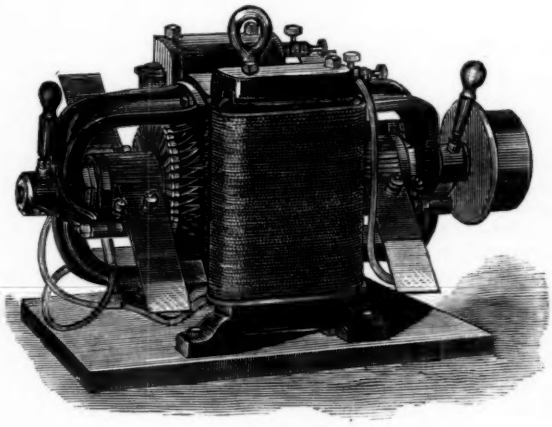


FIG. 1.

The armature is not only mechanically protected on all sides, but this particular enclosing and protecting form of the pole pieces and field-magnets concentrates all the inductive energy directly upon the armature,

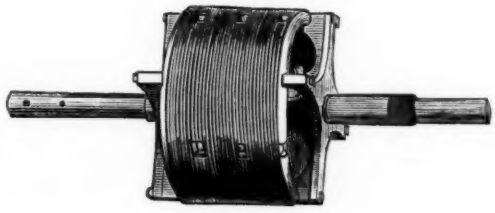


FIG. 2.

and none is wasted. Every pound of iron is thus made an active part of the field-magnets, and does useful work. The commutator is of the simplest possible construction, and can be taken apart and put together with great facility.

FIG. 3.

The brush holders are arranged for greatest possible convenience and safety in handling, and can be instantly adjusted for any number of lights within the capacity of a given machine, in such machines as are not self-regulating.

The generator is graceful in design, and even in the most minute details mechanical advantage has been as much sought after as electrical efficiency.

Every machine for arc lights give a standard current of 10 ampères, and an available electromotive force of at least 45 volts per arc.

In all extended systems of arc lighting, remarks our contemporary (and in many smaller plants), a judicious regard for expenditure of power and saving of carbons requires that the dynamo should be capable of great elasticity in its generative functions. That is, in a circuit having a number of arc lamps, they should be able to burn any lesser number without changing the speed or having the trouble of adjusting the dynamo, and the power required should decrease in proportion. All this must de done without increasing or diminishing the brightness of the remaining lights.

The brushes do not move, nor are there any switches to get out of order. The brushes being stationary, are set always for maximum efficiency and minimum sparking—a result not obtainable in such systems of regulation as require an automatic movement of the brushes to regulate the current. By leaving the brushes in this carefully determined position at all times, the current for one lamp or for 50 lamps will be taken off by the brushes under the conditions of greatest efficiency, which is very hard to accomplish by any automatic movement of the brushes away from the line of highest efficiency.

The McTighe machine is easily taken care of, requiring nothing but oiling and an occasional trimming of the brushes. Lamps may be turned out at will, and the machine will instantly adapt itself to the new condition, and proportionately lessen the expenditure of power on the part of the engine. The lamps may even be all extinguished at once without endangering the armature or insulation.

ELECTRICITY CLASSES.

(*Continued from page* 193.)

The School of Telegraphy and Electrical Engineering, Hanover Square, London.—Since the establishment of this school, in 1868, more than 3,000 pupils have passed through its classes. It is well equipped for giving a thorough practical training in electrical engineering, and its system of instruction will be seen to be of a comprehensive character from the following syllabus of the advanced course for the present term:—The practical work of the advanced course consists of running gas engine, dynamo, arc and incandescent lamps; running dynamos with various resistances; plotting of characteristic curves; running series machine with shunt on field-magnets, or armature and field-magnet; series dynamo as separately-excited machine; exercises in connecting up armature coils to run different numbers of lamps; tests to determine efficiency; winding of armature for different machines; winding of field-magnets for consequent and alternate poles; connections for series machine as motor; running motor for taking tests of back E.M.F. efficiency, &c.; lead of brushes; the adjustment of arc lamps; measurement of candle-power by dispersion or Bunsen photometer; resistance of incandescent lamps while burning by condenser or bridge; tests to determine energy absorbed in a lamp; simultaneous measurement of resistance and candle-power; insulation tests as in factory or for submerged cable; tests for localising faults; inductive capacity by bridge; electrometer tests; cable jointing; connecting up of test tables; voltmeters, ammeters, and their calibration; Thomson's graded galvanometers; Siemens dynamometer; speed counters; reflecting galvanometer (astatic) employed for bridge or discharge tests. The lectures to the advanced class are on the following subjects:—Machines and Lamps—Theory of series and shunt machines, and transmission of power by their means; efficiencies, commercial, of conversion, and electrical; characteristic curves; absorption brakes and transmission dynamometers for tests of efficiency; regulating mechanism of arc lamps; laws of efficiency in motors; photometry. Secondary batteries—Chemical theory and practical details of various forms; methods of

charging with shunt or series machines; employment as regulators; number of ampère hours required to peroxidise or reduce a given weight of lead. Cable testing—Insulation and joint testing by electrometer; capacity tests; insulation by fall of charge; Siemens's formula; slides; absolute electrometer; fault testing in submarine cables by various methods. Conductors—The most recently-determined relations which should exist between the size of a conductor, its absorption of electric energy and consequent heating, its cost, and the cost of electrical energy. C.G.S. System—Fundamental dimensions of units in terms of length, time, and mass; the complete system (electro-static and electro-magnetic) of units derived from fundamental values. Measuring instruments—Theory of galvanometers; winding size and length of coil in relation to current, and its effect on the needle; displacement of coils from the meridian, or from the vertical, as in Obach's galvanometer; angles of maximum sensitiveness; figure of merit; calibration. Land line tests—Insulation; earth currents; measurement of resistance of lines without earth circuit; resistance of earths; contact on lines.

College of Science and Arts, Glasgow.—The day electrical engineering classes are for instruction by lecture and experiment in the principles of magnetism, electricity and their applications to telegraphy, telephony and electric lighting, as well as for the making of apparatus by the students themselves to exemplify the above. Each student has to provide himself with a kit of small tools, which may cost him from 30s. to £2. The fees are £3 3s. for a session extending over eight months, and the class meets from 10 to 11·15 a.m. Students attending this day class have the opportunity of gaining at this college a complete education, fitting them to become electricians or electrical engineers, by attending the mathematical, natural philosophy, mechanics, machine construction, geometrical drawing, and chemistry classes, which meet from 11·30 to 5 p.m., and the fees for the full course of subjects is 11 guineas for the session. Evening classes for the benefit of those engaged in business during the day meet, for advanced electricity and advanced telegraphy, on Mondays from 7·30 to 9·30 p.m.; for junior electricity and electric lighting, with transmission of power, on Tuesdays from 7·30 to 9·30; and for junior electricity and junior telegraphy, on Wednesdays at the same hour. Students have an opportunity of attending electrical, mathematical, engineering, physical and chemical lectures on the other evenings of the week, at the same hours. It will be remembered that a fortnight since we drew attention to the fact that four Whitworth scholarships were gained by students from this college, which is the largest number in any one year from any institution. The teaching is practical rather than theoretical, a special feature being that all the teaching staff have served a regular apprenticeship to their subject, and carried out works; and many of the students have secured appointments with good firms.

Crystal Palace Company's School of Practical Engineering.—The instruction in the electrical division is preparatory for professional articles. In addition to an elementary course, those students who can pass an entrance examination in elementary electricity, as well as in mechanical proficiency, are taught the development and more advanced details of the science, particularly in the practical application of them to the utilisation of electricity in its several forms of lighting, heating, mechanical power, &c.; and the practical construction of telegraphic lines, railway signals, dynamo machines and other electrical apparatus. Students can take either, or both, courses at option. Gentlemen are accepted as extra students for electricity only.

Transmission of Music by Telephone.—The music of the performances at the Brussels Grand Opera House is now transmitted telephonically by the ordinary telegraph wire to the Royal residence at Ostend. The music is perfectly audible. The system employed is that of Van Rysselberghe, who is himself a Belgian.

DYNAMIC INDUCTION IN OCEAN CABLES.

[A COMMUNICATION.]

NORWAY is connected with Germany by a three-cored cable between Arendal and Hoyer. This cable is connected at Hoyer with the underground cable from Hoyer to Hamburg so that the entire extent from Hoyer to Hamburg consists of cable.

Up to June 1st, 1884, only two of the cores were in use, but since then the third has been worked also. The three cores are numbered 1047, 1048 and 1049 respectively. Arendal and Hamburg use 1047, Christiania and Hamburg 1048 (with translation communication to Arendal), and on 1049 Arendal and Berlin are in communication with Hamburg. For all three conductors only keys are employed and polarised apparatus, and there is no automatic system. The line between Arendal to Hamburg is without translation communication.

Both before and after June 1st, 1884, I examined the induction between these conductors by means of a wave apparatus, or "undulator," and as Herr Dresing, engineer of the Great Northern Telegraph Company—to whom I showed last winter the diagrams of the results—kindly states, we have here a good instance of "dynamic induction."

I have not previously seen any observations on dynamic induction by means of an undulator, and I think, therefore, that the following result may be of interest.

1. I first insulated conductor 1047 both at Hamburg and Arendal, so as to have only two conductors or a two-wire cable. The undulator then recorded the induction currents in 1049 when a current passed through 1048.

FIG.1.

FIG.2.

FIG.3.

2. Induction current in 1049 when a current passed through 1048, and 1047 is connected with the earth both at Arendal and Hamburg.

3. Lastly, I sent a current in the same direction simultaneously through 1048 and 1049 and measured the induction currents on 1047. The current was sent through the two conductors with one key.

1. Arendal: 1047 insulated, current in 1048, 1049 to the undulator. Hamburg: 1047 insulated, 1048 and 1049 to earth.

2. Arendal: 1047 to earth, current on 1048, and 1049 to the undulator. Hamburg: all three conductors to earth.

3. Arendal: 1047 to the undulator, current on 1048, and 1049 to earth (?). Hamburg: all three conductors to earth.

The regulation of the undulator was the same during the whole time, and we can therefore see the strength of the currents from the height of the dots.

We see from 1 and 2 that when a current passes through one wire the induction in a three-wire cable (2) is less than in a two-wire cable (1), and from 1 and 3 we see that the induction in the three-wire cable is greater than in the two-wire cable if in the former a current in the same direction begins or terminates simultaneously in two wires.

I shall endeavour to explain the diagrams* of the undulator, and shall therefore speak only of 1.

The pencil strokes indicate each time when the key on 1048 was pressed. The mark of the undulator goes upwards when a copper current arrives from the conductor. The battery on 1048 consisted of 50 Daniell

* The diagrams sent were very indistinct.—EDS. ELEC. REV.

cells with copper to line as the main battery, and 30 cells with zinc to line as a counter battery, which sends a reverse current into the conductor when the main battery is opened.

When the key on 1048 is pressed this conductor is charged with positive electricity, which combines with the negative electricity on the surface of the cable. But the positive electricity acts also distributively upon 1049, and as this conductor is in connection with earth negative electricity flows from both ends of the cable into 1049 and combines there with the positive electricity in 1048. The undulator shows also that on closing the main battery on 1048 a current in the opposite direction has passed through the undulator. On opening the main battery on 1048, and consequently discharging the cable, the negative electricity in 1049, which is now free and seeks to pass to earth, makes a dot on the undulator in a direction opposite to the first. Besides, 1048, immediately after opening the main battery, is charged by the counter battery, and this charge causes the indicator to move in the same direction as a discharge of the main battery. The discharge of the main battery and the charge of the counter battery unite, therefore, together and make the second dot in 1049 larger than the first. The discharge of the counter battery gives, lastly, a dot in the same direction as the charge of the main battery.

Hamburg had also the copper of the main battery and the zinc of the counter battery connected to the Norwegian conductors, and when the current from Hamburg passed through the conductor I endeavoured also to observe the induction currents with the undulator, but they were too feeble. A multiplier showed, however, that they had precisely the same direction as the induction currents at Arendal, and would have given the same curves. We have, also, at Arendal, the same induction currents if we insulate all the three conductors in Hamburg, and it is therefore established that we have here observed "dynamic, or current induction."

A. PETERSEN, *Electrician.*

Arendal, *August 25th*, 1884.

REVIEW

Dynamo-Electric Machinery: A Manual for Students of Electrotechnics. By SILVANUS P. THOMPSON. London: E. and F. N. SPON, 16, Charing Cross.

The appearance of the present volume is caused by a demand for copies of the Cantor Lectures on Dynamo-Electric Machinery, delivered by the author before the Society of Arts in the autumn of 1882; the book, however, though based upon those lectures, is in no sense a mere reprint from them. Prof. Thompson wisely avoids a lengthy introduction and plunges at once into his subject by stating what are the different descriptions of dynamos, *i.e.*, the "series," "shunt," "separately excited," &c., arrangements; each of these methods are shown by plain illustrations. In dealing with the theory of the dynamo the author points out that there are three distinct methods of dealing with the principles of the machine, viz.: (1) a physical method, dealing with the lines of magnetic force and lines of current in which these quantities are made, without further inquiry into their why or how, the basis of the arguments; (2) an algebraical method, founded upon the mathematical laws of electric induction and of theoretical mechanics; and (3) a graphical method, based upon the possibility of representing the action of a dynamo by a so-called "characteristic" curve. In considering the theory under these aspects Prof. Thompson aims first to develop a general physical theory, applicable to all the varied types of dynamo-electric machines, and to trace it out into a number of corollaries bearing upon the construction of such machines. Having recited these consequences, which are deduced from theory, it is then shown how they are verified and embodied in the various forms assumed by the dynamo in practice. After that come chapters on the algebraic and geometrical methods of treating the subject. The last section of the book treats of the dynamo in its functions as a mechanical motor.

In the construction of dynamo-electric machinery the author points out, that it is too often overlooked that the "resistance" of a coil of wire, or of a circuit, is by no means the only obstacle offered to the generation of a momentary current in that coil or circuit; but that, on the contrary, the "self induction" exercised by one part of a coil or circuit upon another part or parts of the same, is a consideration, in many cases quite as important as, and in some cases more important than, the resistance.

As it is a point of great importance that the speed of a dynamo should be uniform, the author advises that the obvious and simple precaution should be taken of placing a heavy flywheel on the axle of the dynamo, and he remarks that it is singular that this is not more generally done.

In chapter III. we have an analysis of the various parts which constitute a complete machine. The author in this chapter, in speaking of the wire on the Gramme ring, states that "the parts of the coils which pass through the interior of the ring . . . . . are comparatively idle. They cut very few lines of force as they rotate, and therefore offer a certain amount of wasteful resistance." This assertion upon which the author so emphatically expresses his opinion will hardly, we believe, be generally accepted; indeed, the point is one which seems fated to remain a vexed question, although we imagine it would be quite possible to arrange an experiment which would set the matter at rest. At the conclusion of chapter IV. (which deals with "the induction of currents in armatures and the distribution of potentials around the collector") it is stated, as the result of experiment, that "the Gramme pattern of ring armature, so far from being an improvement on the Pacinnotti, is distinctly a retrograde step; always supposing that the cost of construction, liability to heating, and other kindred matters be equal for the two."

The descriptions which we have in chapters VII., VIII. and IX. of the various types of machines, commencing with the Pacinnotti, are very good, the characteristics of each type being well explained. In the remaining chapters (which form about one-half of the work) the theory of the dynamo is chiefly dealt with, and is very fully considered.

The work of Prof. Thompson is undoubtedly the very best that has yet been written on the subject, and it is a marked advance beyond what has hitherto been done in this class of electrical literature.

Mortality Amongst Telegraphists in Siam.—The following official notice is posted in the Siamese railway stations:—"The Minister of Posts and Telegraphs hereby informs the public that the British India Government has given notice to the effect that their portion of the line between Bangkok and Tavoy will be closed during the next rainy season on account of the extreme mortality among their officials. The Siamese portion of this line being, however, in the same good condition as before, will be kept open for public use between Bangkok and Pong Sakee, the boundary near the border of the British Burman territory, without interruption, during the time the British portion is closed. Notice will be given whenever the British India Telegraph Administration will be in a position to reopen their portion of this line."

The Telephone in Montreal.—The work of placing telephones in the different fire-stations of the city of Montreal, and connecting them with the central fire alarm office, has just been completed. It is understood, however, that the telephones are to be for the use of the brigade alone.

NOTES.

Electric Lighting.—The *Serapis*, troopship, which is fixed to leave Portsmouth on the 30th inst. with the 2nd Battalion Highland Light Infantry and drafts for Bombay, made a successful trial of her electric illumination last week. She has 101 16-candle lights and 299 of 10-candle power. She has also sixteen 50-candle power yardarm lights. The generating machinery consists of an Edison-Hopkinson dynamo, driven by one of Gwynne's "Invincible" compound engines. The engine was only being driven to 465 revolutions a minute, whereas the *maximum* allowed by the contract is 600.

The electric light will be used in the Birmingham Town Hall during the forthcoming concerts. The lighting will be carried out by Messrs. Winfield and Crompton.

A decidedly novel objection to lighting streets by electricity is that alleged to have been urged by a member of the Government of an Indiana city, who fears that thieves would be enabled to see when they were watched, and, consequently, it would be impossible to catch them.

The Eddystone lighthouse erected by Smeaton has now been rebuilt by local subscriptions on Plymouth Hoe. It will be dedicated as a navigating beacon by the Brethren of Trinity House on the 24th inst., and will probably be lighted by electricity.

The P. and O. steamer *Chusan*, built and engined by Messrs. Caird & Co., Greenock, made her trial trip on Friday week with the most satisfactory results. Every known means have been taken to insure strength, safety, stability, and easy motion. She has accommodation on the main deck for 109 first-class passengers, and 44 second-class on the lower deck. The saloon extends partly across the ship for a distance of 21 feet, and abaft of that the state-rooms are on each side, the total length of the saloon being about 130 feet. The engines are inverted direct-acting compound, indicating 3,750 horse-power; cylinders, 52-inch and 96-inch diameter; stroke, 56; three double-ended boilers, having 18 furnaces—all to carry a working pressure of 90 lb. steam. The ship has been fitted with incandescent lamps by Messrs. Siemens Bros., of London. Binko's patent electric bells are also fitted up all through the ship.

The Swiss Electrical Company has lighted the Cantonal Hospital at Lausanne on the Edison system. The installation comprises 236 lamps and three dynamos, the latter being driven by three turbines. The company also has a central station in the same town, where there are two dynamos driven by two turbines of 35 horse-power each. These supply current to 280 lamps.

For over three months a test of electric lighting of the streets of Toronto has been going on between the Toronto and Canada Electric Light Companies, the latter being the Van Depoele and the former the Hochhausen system. The city council gave the Toronto Company the contract by a vote of 16 to 14, the term to run concurrently with the gas contract—four and a half years.

On Monday a vessel built entirely of steel, and specially designed for the direct service of the New Zealand Shipping Company, Limited, of London, was launched from the shipbuilding yards of Messrs. J. Elder & Co., Fairfield, Govan. All the latest improvements have been introduced, including the electric light, which is fitted throughout the ship. Independent of the electric light incandescent lamps, others of the most improved description have been fitted up. As the vessel left the ways she was named *Kaikoura*.

Messrs. William Denny and Brothers, Dumbarton, launched for the Shaw, Savill, and Albion Company, Limited, London, the s.s. *Tainui*. The vessel is intended for the New Zealand trade. Three hundred incandescent lamps have been fitted throughout the ship. A sister ship, the s.s. *Arawa*, will be launched on an early date, and will be similarly lighted.

The Telephone in Luxemburg.—The authorities of Luxemburg are discussing the advisability of introducing the telephone into that country, and we learn that the Administration hopes shortly to organise a public service in the capital and suburbs.

Long-Distance Telephoning.—The editor of the *Demerara Chronicle* was recently favoured with an opportunity of testing the capability of the Ader telephone for transmitting sound over long distances. Mr. G. C. Benson, Superintendent of Government Telegraphs, was at Pln. Goldstone Hall, Berbice, and connection with that estate and the telephonic system in town having been established, the editor was enabled to carry on a conversation with Mr. Benson, and also with Mr. W. F. Bridges. The instruments worked admirably, the words uttered being most distinctly heard, whilst recognition of the voices of the gentlemen at the other end of the connection was perfectly easy.

The Concessions to the Telephone Companies.—At a meeting of the directors of the Glasgow Chamber of Commerce and Manufacturers, held on Monday last, the Chairman, in moving the approval of the minutes, said it would be satisfactory to the directors to notice that Mr. Fawcett had granted the request which the Chamber made in regard to not charging the royalty of 10 per cent. on the private lines of telephones; and also that it was intended to connect telephone offices with the Post Office telegraph offices, so that subscribers to telephone companies might telephone or telegraph, without leaving their rooms, to any part of the United Kingdom, or to any part of the world. He thought that was a very liberal concession.

Telegraph and Telephone Wires.—The Government of New South Wales has approved of the design by Mr. E. C. Cracknell (*see* ELECTRICAL REVIEW for June 14th) for carrying telegraph and telephone wires overhead, and accepted a tender from Messrs. D. and W. Robertson for the supply of the ironwork necessary for testing its value in Sydney. As the wires on the telegraph posts in Sydney are very numerous, and the necessity to adopt some other method of carrying the wires is very urgent, Mr. Cracknell has devised a scheme by which the wires will be bunched together in cables.

The Van Rysselberghe System.—The Commission of the Antwerp Universal Exhibition, desirous of having a room at the Exhibition set apart for telephonic musical auditions, where the public might hear at Antwerp the concerts given in the principal towns of Belgium, applied to M. Van Rysselberghe to make arrangements for utilising the telegraph wires for this purpose. A trial took place last week, we learn from the *Belgian News*, and it surpassed the most sanguine expectations. The music at the Vauxhall in Brussels could be heard in the Northern Station at Brussels, as well as in the station at Antwerp. Not only was the orchestral part most distinctly reproduced, but the violin solo in Gounod's "Méditation" reached Antwerp without any of the details of execution escaping the audience. At the time the music in Brussels was telephoned to Antwerp by means of the telegraph wires, these were not taken off their ordinary work, but continued to transmit despatches in all directions. Six microphones had been fixed to the two small columns of the kiosk of the Vauxhall, so as to be on a level with the musical instruments. The carbon transmitters were of the model devised by M. Van Rysselberghe, and were all mounted in parallel and actuated by a small Faure accumulator. They were connected to the central office of the Compagnie des Téléphones. Thence the circuit was prolonged by a double wire, to avoid tele-

phonic induction, as far as the central telegraph station (Brussels Nord), and was made to communicate with the office of the director, M. Delarge, where 10 Bell receivers had been intercalated in the circuit to allow of the music of the concert being heard in Brussels, while being transmitted to the eastern station at Antwerp. In M. Delarge's office in Brussels were M. Van den Peereboom, Minister of Railways, Posts, and Telegraphs, and the principal officials of the State Telegraph Department, who repeatedly and most warmly congratulated the inventor, M. Van Rysselberghe, on the inauguration of long distance telephony, which will be at the disposal of the public in a few days. At the station at Antwerp were Prof. Rousseau, President of the Committee of Electricity at the Antwerp Exhibition, several members of the commission, MM. Van Gend, De Caters, Van Bellinghen, and De Brown de Tiège, directors of the Bell Company, Lieutenant Lemière of the military telegraphic department at Antwerp, M. Charles Mourlon, manager of the works in which all the Van Rysselberghe apparatus were constructed, and lastly M. Berlin, the engineer under whose charge the trial took place, and who has the management of the arrangements necessary for the appropriation of the Belgian telegraphic network to telephony. By the desire of the Minister of Railways, Posts, and Telegraphs, the experiments were repeated with the same success on the following day, in presence of nearly all the members of the Cabinet.

The Chinese Telegraphs.—The Chinese Government land lines to Tientsin, which we last week announced were interrupted, were restored at the end of the week; the Eastern and Indo-European Telegraph Companies notify, however, that messages will for a time be subject to some delay owing to pressure of work. The Eastern, the Indo-European, and the Great Northern Telegraph Companies further state that a steam launch will run daily between Sharp Peak, the landing place of the cable, and Foochow, to carry telegrams between the two points. The restriction on the use of code words will not apply to telegrams so forwarded, but as the launch service is liable at any time to interruption, telegrams will only be accepted at the risk of the senders.

A communication from the Great Northern Telegraph Company, on Thursday, stated that, the steam launch service between Sharp Peak and Foochow having been forcibly interrupted by the Chinese military authorities, telegrams for Foochow can only be accepted for transmission by the Chinese Government land lines from Shanghai, and they must be written in plain English, the use of code words being forbidden.

The Bennett-Mackay Cable.—The *Financial News* of Wednesday said :—"The new cable enterprise seems to make very slow progress at this end, although the *New York Herald* has already published despatches purporting to have come by this line. At the offices of the company here the officials in charge profess to be wholly ignorant of any arrangements for beginning work on the European side."

The s.s. *Faraday* has arrived at Messrs. Siemens' telegraph works at Charlton, after having successfully laid the first portion of the second cable, and is now engaged in taking on board the second portion. It is hoped, states a contemporary, that both cables will be in working order by the 1st of October.

The Telegraph in Central Asia.—The telegraph line between Samarcand and Bokhara was opened on Tuesday.

The Telegraph in South Africa.—Direct telegraphic communication with Pretoria has been re-established, *vid* the Free State, after an interruption of three years' duration.

Telegraph Revenue.—The receipts from April 1st to September 6th, 1884, were £755,000 against £750,000 from April 1st to September 8th, 1883.

Foreign Honours.—It has been stated that Dr. Cornelius Herz has been made a Commander of the French Legion of Honour, and that he is the first foreign scientist to enjoy this distinction. A correspondent calls attention to the fact that Mr. Charles F. Brush was made a Chevalier of the Legion in 1881 by the French Government, in connection with the Electrical Exposition at Paris.

Storage Batteries.—A dispatch of Aug. 19th, from Washington, says :—"Priority of invention has been awarded Brush as against Keith, Shaw, Faure, Maloney, and Burger in all pending interferences, thereby entitling Brush to the broad claims on secondary batteries."

Lighthouse Experiments.—The scientific observations in relation to the lighthouse experiments which are being conducted at the South Foreland are virtually completed. Observations on an extensive scale are now, stated the *Times* on Saturday last, being conducted by the Elder Brethren of the Trinity House, the captains of the mail packets, the Peninsular and Oriental liners, pilot vessels of different nationalities using the Channel, trading vessels plying between England and foreign ports, and by several French cruisers. The most important tests will take place during the autumn, into which the experiments will be extended, when hazy weather and a greater variety in the conditions of the atmosphere may be expected. The Committee of the Elder Brethren will not be able to frame their report to the Board of Trade until the observations are collected from the different sources named. So far as has been ascertained at present, there seems to be very little difference for all practical purposes between gas and paraffin oil. The gas-light, if anything, is slightly superior in fine weather, and the electric light is overwhelmingly superior to both the other lights. The crucial test of the electric light, however, will be in hazy weather, and it is stated that in some experiments which have already taken place when the weather was rather thick the light did not hold its own against the other luminants.

Electric Light Companies.—The "City" writer of *Truth* says that, one after another, the electric light companies, which owe their existence to the electric light mania of 1881, are collapsing. Rarely, he remarks, has the promoter's greed and its baneful consequences been so strikingly illustrated as in the case of the electric light, and the result is, apart from the loss of many millions stirling, a delay of at least some years in the more general introduction of the new light in this country; for the British investor will, very naturally, fight shy of a branch of industry which has cost him so dear. The last "Brush" offspring which has had to pay the penalty of non-success is the Eastern Electric Light and Power Company, the bulk of the amount paid on the shares of which, some £148,000, may be considered as lost.

Engineering Work on the Mersey Dock Estate.—The engineer to the Mersey Docks and Harbour Board has just reported that the total amount expended in the engineer's department during the year, to the 30th June, was £514,287. The principal works accomplished were the completion and opening of the Hornby Dock, the fixing of additional electric beacon lights at the Alexandra and Hornby Docks, and a considerable extension of the high level coal railway.

The New York Underground Road.—Mayor Edson, of New York, has vetoed the resolution of the Aldermen granting a franchise, without charge, to a surface railroad for Broadway. The prospects of the underground electric road, states the New York *Electrical World*, were never brighter. Negotiations are now pending for the construction of the first section from the Battery to Forty-second Street, and the work of excavation will probably begin in a few weeks.

Embezzlement.—William Johnson, an ex-policeman, has been sentenced to four months imprisonment, at Blackburn, for embezzling £8 belonging to the Lancashire and Cheshire Telephonic Exchange Company, Limited.

British Association.—At the conversazione held by the Governors of the McGill University on Thursday evening, the 28th ult., in honour of the meeting of the British Association, an improved nicol-prism polariscope was exhibited by Messrs. Harvey and Peak, of London, objects being shown upon a screen by electric and oxy-hydrogen lights.

Overhead Wires.—At the meeting of the City Commissioners of Sewers on Tuesday, a letter was read from the Wandsworth Board of Works, inquiring whether the Commissioners would contribute towards the cost of an Appeal to the House of Lords in the matter of overhead wires. The letter was referred for consideration to the Streets Committee.

The Nile Expedition.—The Royal Engineer officers who went out on Tuesday in the *Pelican* will form part of the corps to construct the telegraph, which will be a light air line, carried on temporary poles along the banks of the Nile. A marine line laid along the bed of the river was thought of, but discarded on account of its aggregate weight and the labour which would be required to lay it.

Though the arrangements are not yet completed, states the *Times*, there is no doubt whatever that the military authorities have decided upon utilising the services of at least a dozen non-commissioned officers and men of the Telegraph Companies of the 24th Middlesex (Post-office) Rifle Volunteers for service in the campaign. These are all skilled manipulators, and include several who were in the Egyptian campaign. All being enrolled in the Army Reserve, they will leave for Chatham about the 24th inst., where they will exchange their dark grey uniforms for the scarlet of the Royal Engineers, to the Telegraph Battalion of which arm of the service they will be attached.

Severe Thunderstorms in Scotland.—Last week a series of thunderstorms was experienced in Scotland. On Tuesday afternoon a farm servant, near Dundee, was struck by lightning. He remained insensible for upwards of an hour, and during the afternoon was in a delirious state, but he gradually recovered. At Blairgowrie the telegraph instrument at the railway station was struck by lightning and rendered useless, the booking clerk having a narrow escape. Mr. Geddes, station agent at Dalquire, on the Highland Railway, near Dunkeld, was struck by lightning whilst operating on the telegraphic instrument, his arm, side, and leg being paralysed. A number of cows and other animals in various parts were killed or injured.

During a thunderstorm in Orkney, last week, Miss Wilhelmina Leask, residing with her mother at Knockhall, near Stromness, was killed by lightning. The girl had been in the harvest field with some friends, and when the storm came on they separated. Shortly afterwards the young woman was found lying on her face, quite dead. The lightning struck her on the neck, tearing and burning her clothes, breaking a watch in her pocket, and tearing the boots from her feet, afterwards making a large hole in the earth.

The Post Office and the Telephones.—The following are among the resolutions to be submitted to the Associated Chambers of Commerce at the meeting to be held at Wolverhampton on the 30th September and the 1st of October next:—By the Leicester Chamber.—That this association regards with satisfaction the statement made by the Postmaster-General of the improved terms upon which he is willing to grant licenses for telephonic communication, but is nevertheless of opinion that all such communication should be brought under direct Government control, with a view to a complete and uniform system for the whole of the United Kingdom. By the Hull Chamber.—That it is desirable that the present excessive rates charged for telephonic communication by the Post Office Exchange, or for private wires supplied by them should be reduced, and that representation be made to the Postmaster-General respectfully to request that he will grant licenses on such nominal terms and royalties to responsible persons or companies for the establishment of telephonic exchanges and trunk lines as will enable them to carry on such exchanges at the smallest cost to the public.

The Philadelphia Electrical Conference.—The National Electrical Conference convened by Congress in connection with the Electrical Exhibition, began its sessions in Philadelphia on Tuesday. Addresses were made by the President of the Conference, Professor Rowland, of John Hopkins University, Baltimore; also by Sir William Thomson, the Vice-President. The practical work of the conference began with a discussion on the work of the United States Signal Office in relation to electrical observation. The conference will hereafter discuss the necessity for a national bureau of electrical standards, the adoption of an international system of electrical units, and the theory of dynamo-electric machines. Professor George Forbes, of London, on Tuesday evening delivered a lecture on dynamo-electric machinery.

The Conference, on Wednesday, adopted resolutions that steps should be taken to legalise in America the ohm adopted by the Paris Conference, also the ampère and volt as electrical standards of measure. It was proposed by Mr. William H. Preece that the committee should consider the adoption of the English watt as a unit of power; this was also adopted. Sir William Thomson, Mr. Preece, and other British scientists take an active part in the discussions.

Marcel Deprez's Experiments at Creil.—The time is approaching, remarks the *Bulletin de la Compagnie Internationale des Téléphones*, when the Creil experiments will enable us to pass an opinion on the practical value of the theories of M. Marcel Deprez relative to the transmission of power to a distance. The two engines which are to furnish a motive power of 300-H.P. are ready, and the transmission will probably be attempted before the close of the present month. At Paris, all is ready for the receivers which will be employed in the workshops of the Gare du Nord, either for the production of electric light, or for driving machinery, pumps, &c. The electric conductor has yet to be manufactured and erected; its diameter is to be 5 millimetres, which seems to us rather thin for the transmission of 100 to 150-horse power to a distance of 50,300 metres. The conductor is to be formed of copper, and, as we have already notified, opinions vary as to whether it should be bare or insulated. It is not, therefore, too late to consider what precautions may be taken. In the experiments for which he has taken the responsibility, M. Marcel Deprez proposes to transmit to Paris 100 to 150-H.P. Fixing the rendering at 50 per cent., he requires at Creil 200 to 300-H.P. We will ignore the mechanical losses between the engine and the generator, and see what electrical elements correspond to this power. 200-H.P. represents, about 150,000 watts; and as the current strength is fixed at 20 ampères, the electromotive force will be 7500 volts. For 300-H.P., with the same current, the electromotive force should reach 11,250 volts. Confining ourselves to the first case, we see that the highest electromotive force (1500 to 2000 volts) of which electricians have hitherto dared to make use, is considerably exceeded. It is not surprising, therefore, that one should be alarmed at the danger to which the public will be exposed if a current comparable to lightning were placed at their doors. To give some idea of this, we must refer to the accidents which have already hapened through the employment of electric currents. In August, 1882, during the *fete de la Presse* at the Tuileries, two young men fell dead; the one on the spot, the other a few minutes after, having touched

the naked wire conducting the current from a dynamo to some electric light apparatus. According to the inquest, the mean difference of potential between the outward and return wire of the circuit was about 500 volts, and the difference of tension between the naked wire at the point touched and the soil, was approximately estimated at 250 volts. Death was caused by the derivation of a portion of the current through the body, which made contact with the wire at two different points. The post-mortem examination led to the conclusion that death resulted from cessation of the heart's action ; instantaneous in one of the victims, less rapid but no less decided in the other. These brief indications suffice to justify precautionary measures in the establishment of such conductors, and we know of nothing but the laying of the wires in trenches which could prevent accidents.

A New Unit.—The tendency to a multiplication of units, upon which we (the *Mechanical World*) have before remarked, still exists, and we have suggestions continually cropping up for their increase. Among the most wildly absurd of them we may class that made by Mr. W. H. Preece at the recent meeting of the British Association. The electrical horse-power is 746 watts ; this number does not please Mr. Preece, and he desires to alter it to 1,000, and in order to preserve the co-relation between the electrical and the mechanical horse-power he coolly proposes that the number 33,000 should be changed to 44,236 foot-pounds per minute. Evidently Mr. Preece is a theoretician of the most theoretical order and utterly ignorant of applied mechanics. We see, however, no valid objection to his proposed unit *per se*. It would be very convenient for electricians, but it must not be called a horse-power or the equivalent of a horse-power. In honour of its inventor let it be called the *Preece*. It will be easy to relate it to the actual horse-power thus : the *Preece* equals one and one-third horse-power, that is to say as nearly as can be calculated, four donkey-power. We have then 250 volt ampères = 1 donkey-power and 4 donkey-power = 1 *Preece*. The connecting link would be 3 electrical donkey-power = 1 mechanical horse-power. We have thus introduced for the sake of compactness another new unit ; following precedent we should give the name of some physicist to it, but unfortunately we cannot think of one worthy of coming into the chain, and will therefore leave the donkey alone. It is awkward—"1 *Preece* = 4 donkey-power" looks personal, but then 746 watts = 1 horse-power is equally personal ; it is one of the penalties that must be paid by genius. We should like to depose the donkey, but regretfully confess our inability.

Female Employment.—According to the census returns of 1881, there were 2,228 females employed in the telegraph and telephone services.

Electric Light to the Rescue.—Cork was at nine o'clock on Wednesday night suddenly plunged into darkness, all the gas in the streets and shops being extinguished. Considerable excitement prevailed, and those who had friends at the theatre rushed in that direction. The theatre was the only building in which the gas remained lighted.

Electricity versus Compressed Air.—Mr. Radcliffe Ward writing to the *Pall Mall Gazette*, in answer to Colonel Beaumont, says :—"The Leytonstone trials were arranged for and carried out by me with a purely experimental car brought from Belgium by Mr. Philippart. Colonel Beaumont must know perfectly well that the lumbering, heavy Leytonstone car by no means represents the existing electrical appliances obtainable even in the open market. Colonel Beaumont has no foundation, in fact, for making the statement that the efficiency was 1 per cent. of the initial power. Those who know anything of the subject are aware that this is an absurd statement to put forward to damage electricity as compared with compressed air. For those who do not understand, let me observe that both electricity and compressed air as applied to tramway work, act as reservoirs for energy produced from an extraneous source—say a stationary steam engine. Now, compressed air appliances are both more costly and weigh more than electrical appliances for a given power stored and operated. I believe that Colonel Beaumont claims to run eight miles with one charge on a moderately level road ; an electric car has actually run 20 miles in Paris over various grades with one charge. Yet the compressed air car represents the work of years and much money spent on developing it ; only a comparatively small amount of time and money has been given to the electric car, yet it already runs more than double the distance. However possible, from a purely mechanical point of view, it may be to work the underground trains by ponderous compressed air engines, such cannot compete for economy with an electric system with electric engines and accumulators."

The Telephone in Russia. — The telephone has become an established fact in several of the largest Russian cities, notably St. Petersburg, Moscow, Odessa, Riga, and Warsaw. St. Petersburg is traversed in every part by at least 1,500 versts of wires on the Bell system. The works and factories in the quarters of Vibourg, Krestovsky, and Old Petersburg are all in connection with the central portion of the city, as are also the great Government offices with the barracks, police-courts, and prisons, so that orders from head-quarters can be instantaneously communicated and carried out. The wires now extend to the fortresses of Gatschina and Peterhof, and the large smelting works of Pontilow and Alexandrovsky, some eight or ten versts distant, correspond directly with the Nevsky Perspective and the Morskaïa. An office has been opened for the benefit of the public, who can send a message for 25 copecks.

Competition in Telephones.—The Trinidad papers announce that Mr. Gray, the manager of the American Telephone Exchange in Port of Spain, has been recently superseded by another gentleman sent out by the parent company in New York. Subsequently Mr. Gray submitted to the mercantile community of Port of Spain a proposal to form a new telephone company, with lower rates than the present one, and bound himself to have everything ready to start in January next. Most of the leading merchants present agreed to the proposal, and signed a preliminary arrangement. So it would seem the "grey" mare proved to be the better horse.

Personal.—Mr. Edgar Beckingsale has opened an office at Gresham Press Buildings, Little Bridge Street, E.C., also retaining his Glasgow address, 59, St. Vincent Street. Mr. Beckingsale, who has had a long experience in electrical practice, contracts for the supply and erection of electrical plant, giving his attention more particularly to electric lighting and power machinery. Mr. Beckingsale had eight years' service with The Telegraph Construction and Maintenance Company, which, at the time, was the great practical school for electricians. For this company, and later on for the India Rubber and Gutta Percha Company, Silvertown, he has visited all parts of the world. He was, until recently, connected with the Brush Company of Scotland, and on the winding up of that concern he carried out a private contract for lighting the ship yard of Messrs. Elders, at Govan. Mr. Beckingsale's long experience should entitle him to important contracts.

Overhead Wires in London.—Says the New York *Electrical Review* :—"Considering the unanimity and persistence with which the American press has insisted that overhead wires are not allowed in London, it is interesting to note the discussion that is now going on in English papers concerning the rapid increase in the number of overhead wires in the metropolis. The fact is that, as compared with the whole number of wires in use there, the number of actually buried conductors in London is very small."

CITY NOTES, REPORTS, MEETINGS, &c.

The Pilsen-Joel and General Electric Light Company, Limited.

MR. HENRY F. JOEL, C.E., has addressed the following circular to the shareholders of this company :—

"At the general meeting of the company held last Thursday (the 28th ultimo), at Cannon Street Hotel, E.C., I took occasion to criticise the management of the company's business as follows :—

"*Extract from* ELECTRICAL REVIEW, *August 30th.*

"'Mr. Joel said, with reference to the statement in the report, that "no company has fared better in this country than ourselves," that the Anglo-American Brush Corporation, by careful management, had succeeded much better than this company. They (the Pilsen Company) had had practically the best lamp in the market, a first-class organisation, and they started with greater advantages than any other company; they had perfect confidence in their directors, and there was no Stock Exchange speculation to stop them, so that they ought to have done better. He had written to various companies and others with the view of getting some data as to the electric lighting being carried on in this country. He had ascertained that very little work had been done by the companies, but private firms had done a great deal, and had done it well and properly. The tables with which he had been furnished showed a record of a very great amount of electric lighting in this country; so it was evident that there was work to be done, and their company was not doing it. He attributed the losses of £6,000 for the year before the last meeting, and of £11,000 for the year just past to the fact that the directors had ignored technical assistance; they had tried to manage a technical business without proper advice and had failed, whilst others had good assistance at their backs, and had done better. He thought it a great hardship that he had to leave the company after twelve months, but there was no help for it, he had to go. He had a great interest in the company, and he wished to look after his investments. He believed a great deal of the money had gone in experiments to instruct the directors and the factory committee in the very elements of electrical work, whereas if they had had proper advice this would not have been necessary. No mention was made in the report of the Colonial patents; but surely they were of some value. The directors said there was a chance of carrying on business by the payment of royalties; six months ago he brought an offer from people who were willing to manufacture their lamps and pay a royalty upon them, and if that had been accepted he had no doubt he could have got twenty other firms to do the same. They would probably have got £2 per lamp, and then their patents would have been worth something immediately. He had received 33 letters from persons who had used the Pilsen lamp in Germany, and all were splendid testimonials, so that they had patents which were of real value. Mr. Joel handed to the chairman twelve questions relating to the results of installations and to the management generally.'

"At the same meeting the resignation of the directors was accepted, and it was resolved to elect four new directors.

"Mr. Ellis proposed the following gentlemen, viz. :—Sir Rawson Rawson (the former chairman), Mr. Scriven (a former director), Mr. A. Parrish and Mr. Whately, but the feeling of the majority of the independent shareholders present was, that Mr. Whately (a solicitor and a non-shareholder) was not a suitable man for the fourth director. The result was that :—

"*Extract from* ELECTRICIAN.

"'Mr. Quilter moved as an amendment, "That only three directors be elected at the present meeting, and that the remaining vacancy be filled up afterwards and subject to the shareholders' approval at their next meeting."

"'Mr. Barker seconded the amendment, which was carried, 13 voting for it and 11 against.

"'It was next resolved that Sir R. W. Rawson, Mr. Scriven, and Mr. Alfred Parrish should be the three gentlemen appointed.'

"The next meeting of the company will be held at their offices, Telegraph Street, Moorgate Street, London, on the 12th September next, at 2 p.m.

"The questions I now put to the shareholders are :—

"1. Are you content to lose all your remaining property in the company? If not;

"2. Will you take some interest in the future management of the company by electing the independent shareholders' director, and thus endorse Mr. Quilter's amendment?

"I have been invited by several shareholders, representing some thousands of shares, to offer myself for the vacant directorship, and if I receive your cordial support I am willing to give a great deal of time and attention to further the company's business.

"I fully agree :—

"(*a.*) That no further calls be made on any account.

"(*b.*) That the company at once cease all operations as a manufacturing company; close the factory and offices and dismiss the staff.

"(*c.*) That the stock, tools, rental, installations, and all other realisable assets of the company be at once sold by tender, and after settling all liabilities the money be divided (by means of an Order of the Court, or otherwise) *pro rata* amongst the shareholders. I estimate that fully 10s. per share should be thus divided.

"(*d.*) The patents, both in the United Kingdom and in the Colonies, should be farmed out under licenses, for royalties (I believe that over £5,000 per annum is obtained in this way from the Austrian German-Pilsen Lamp patents, in those countries), at the same time the directors should let it be known that the patents are for sale, and no reasonable offer should be refused.

"(*e.*) If, however, a sufficiently lucrative return can be made by royalties, the directors may consider it advisable to keep the company intact (subject to the approval of the shareholders), in preference to selling all the patents and winding up the company. This course would allow any great rise in the electric-lighting industry to be taken advantage of.

"To carry out the above programme will involve but little expense, and I am of opinion that royalties could be obtained at once to cover all future expenses, so that the assets for the company would not be touched.

"Speaking for myself, I consider that I can help the company to carry out the above programme perhaps better than any other shareholder. I am well known in the electrical world, and know all the leading electrical companies and firms throughout the country, and it is to such firms that licences for royalties will be granted.

"I have had a very great experience in the Pilsen lamp, the Gatehouse Incandescent lamp, and my own lamp, and my position in my profession gives me a right to speak with authority as to their merits. I have interested myself very much already to secure customers for royalties, and also to sell the assets of the company, and I fully believe I can succeed in doing so. Further, I am a shareholder holding 600 ordinary shares, 400 of which were original shares.

"I submit that the vacant directorship should be filled by a technical man; there will be three commercial directors, and there should be one technical director to guide and assist them. If the whole of the business of the company is vested in commercial directors only, those directors must apply to an outside technical man or firm to do the work as agents for them, thus incurring great and avoidable expense, and disclosing the company's business to competing interests.

"I appeal to the shareholders to look with some interest after the valuable assets, and very valuable patents yet left to the company. With good management, in the sale of the goods and patents, particularly the Colonial patents, and by energetically pushing the granting of licenses for royalties, I am of opinion that it is yet possible to recover the whole of the money paid by the shareholders, and I say this after full consideration, and a knowledge of the whole of the circumstances.

"If you agree with me and are prepared to support me, will you please attend the meeting to be held at the offices of the company in Telegraph Street, London, on Friday, the 12th September next, at 2 p.m., and vote in my favour (or in that of some other properly qualified technical man), and also sign and return the enclosed proxy to me not later than Tuesday evening, the 9th September next, otherwise it will be too late to be used at the meeting."

Submarine Telegraph between France and England

(SOCIÉTÉ CARMICHAEL ET CIE).—A dividend for the six months ended 30th June, 1884, at the rate of 14½ per cent. per annum, is payable, less income-tax, on presentation of the coupons, either at the Union Bank of London, 2, Princes Street, E.C., or to Mr. P. Gil, banker, 6, Boulevard des Capucines, Paris.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending September, 5th were £2,450, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The Great Northern Telegraph Company. The receipts for August, 1884, £26,800, and from 1st January to 31st August, 1884, £182,680; for the corresponding months of 1883, £168,386; and for 1882, £161,145.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month ending August 31st, were £3,690.

NEW PATENTS—1884.

11988. "Learning change ringing on peals of bells (the bells themselves being silent) by means of electricity." T. F. LANE. Dated September 4.

11991. "Electrical carpet cleaner." H. SCHVIGES, C. GOSNELL. Dated September 4.

12001. "Galvanic batteries." W. R. LAKE. (Communicated by L. Knaffe.) Dated September 4.

12003. "Dynamo-electric machines." P. B. ELWELL. Dated September 4.

12006. "Bell signals." E. P. TIMMIS. Dated September 4.

12021. "Electric clocks with method for striking hours and household alarms." J. ESHELBY. Dated September 5.

12026. "Self-working electrical clock." J. G. KNIGHT. Dated September 5.

12028. "Galvanic batteries." S. H. EMMENS, United Patents Corporation. Dated September 5.

12060. "Electrical safety apparatus for lift cages." N. COWARD. Dated September 5.

12064. "Incandescent electric apparatus and the manufacture thereof." J. S. WILLIAMS. Dated September 5.

12075. "Telephonic connections." T. BALLARD. Dated September 6.

12076. "Telephonic apparatus." T. BALLARD. Dated September 6.

12127. "Incandescent electric lamps." W. P. THOMPSON. (Communicated by O. A. Moses.) Dated September 8. (*Complete.*)

12153. "Electrical torsion pendulum." A. J. BOULT. (Communicated by Gebrüder Rabe.) Dated September 8.

12215. "Electric telegraphs." F. H. W. HIGGINS. Dated September 9.

12218. "Dynamic apparatus or machines for the development and utilisation of electric force and in the construction of such machines or parts thereof." J. S. WILLIAMS. Dated September 9.

12219. "Portable dynamic instruments for the conversion of manual force into electric force and the utilisation thereof." J. S. WILLIAMS. Dated September 9.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1883.

5865. "Dynamo-electric machines." E. C. WARBURTON and L. J. CROSSLEY. Dated December 26. 6d. The object of our invention is to improve the construction of dynamos and motors by giving rotary motion to the field-magnets as well as to the armatures in directions opposite to and within each other by simple and efficient mechanism; the magnets may have any even number of poles. Fig. 1 is a sectional plan, and fig. 2 is an end view of a dynamo-electric machine constructed according to the invention. *a*, a^1, are two parallel shafts connected in the following manner:—a toothed spur wheel, *b*, is keyed or secured to one shaft, *a*, which gears into a similar wheel, b^1, of the same diameter free to revolve loosely on the second shaft, a^1; magnets, *c*, c^1, or armatures, *d*, d^1, may be secured to barrels on these spur wheels,

FIG. 1.

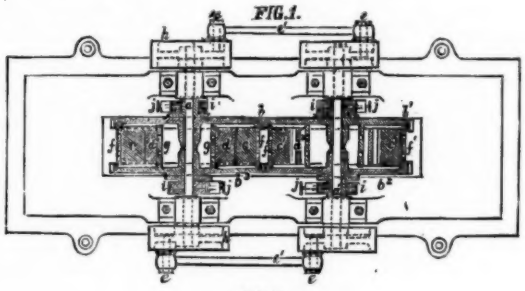
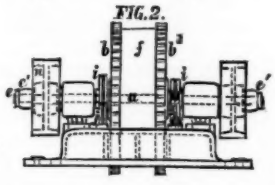


FIG. 2.



b, b^1; the second shaft is driven from the first by means of cranks, *e*, and a connecting rod, e^1, or in other convenient manner. Each of these two shafts carries a revolving field-magnet, *c*, or c^1, with an armature, *d*, or d^1, revolving within it, and in the opposite direction, or the armature may be outside the field-magnet. To the second shaft, a^1, is keyed or secured another spur wheel, b^2, of equal diameter to those already described, and this wheel gears into and turns a similar wheel, b^3, which turns loosely on the first shaft, *a*. A convenient manner of constructing the revolving magnets and armatures is as follows:—To one side of the spur wheel, *b*, fixed to the first shaft, *a*, we cast a barrel of thin metal, *f*, parallel with the shaft, *a*; the field-magnet, *c*, is secured to the inner side of this barrel, *f*; loose on this shaft is a wheel, b^3, with a similar barrel, *g*, but smaller in diameter than that above mentioned; to the outer surface of this barrel, *g*, the armature, *d*, is secured; the magnet, *c*, and armature, *d*, lie in close proximity to one another; the boss of the loose wheel, b^3, which carries the armature, *d*, on its barrel, *g*, is secured to or cast in one piece with the spur wheel, b^3, which is driven from the second shaft, a^1, by the spur wheel, b^2. The field-magnet, c^1, and armature, d^1, on the second shaft, a^1, are made in a similar manner to those already described, the barrel which carries the armature being cast with the spur wheel, b^1, loose on the second shaft, a^1, while the barrel which carries the magnet is fixed to the spur wheel fast on the second shaft. When used as a dynamo, motion is given to the first shaft, *a*, by pulleys, *h*, or in any convenient manner, and communicated by the crank, *e*, and connecting rod, e^1, to the second shaft, a^1; the spur wheel, b^1, with the armature, d^1, secured to its barrel, g^1, revolves loosely on this shaft, a^1, being turned by the spur wheel, *b*, on the first shaft, *a*; motion is given to the second field-magnet, c^1, by the second shaft, a^1, to which it is secured, and this barrel, f^1, and magnet, c^1, transmit motion by the pair of spur wheels to the armature, *d*, on the first shaft, *a*. Commutators which are constructed so as to reverse and maintain currents in and from the field-magnets and armatures, *i*, *i*, are fitted on the sides of the spur wheels; the brushes, *j*, *j*, are fitted to the frame of the machine.

1884.

8793. "Improvements in relays or telegraphic receiving instruments." J. S. LAMAR. Dated June 10. 6d. Has relation to relays or telegraphic receiving instruments, and it consists essentially in a vibratory steel magnet, acting by its own attraction upon the core of an electro-magnet to break circuit, and by means of the mutual repulsion between said electro-magnet and said steel magnet to make circuit. Fig. 1 illustrates a sectional elevation of the apparatus, and fig. 2 a top plan view thereof. A, designates the base of the instrument, and B an electro magnet, which is preferably made adjustable, C represents a thumb screw working in a bearing, D, and adapted to move the electro-magnet

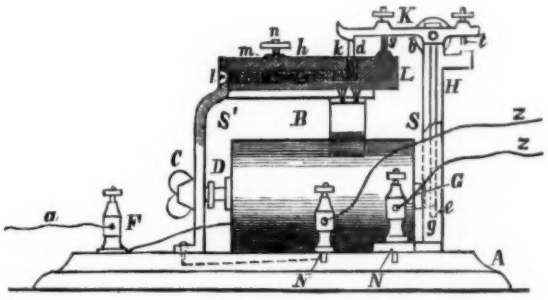


FIG. 1.

when turned, F, F, indicate binding-posts for the line wires, *a*, *a*, with which the electro-magnet is in circuit, G represents the soft iron core of the electro-magnet, H represents a steel magnet having a vivot, *b*, seated in bearings, *c*, which are preferably made adjustable by employing screws for the purpose. The steel magnet is provided with a rigid arm, K, which extends at an angle with the magnet and said arm is provided with a downwardly extending point of platinum or other metal, as indicated at *d*.

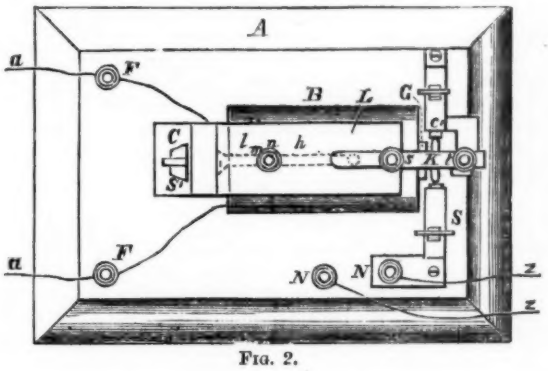


FIG. 2.

The steel magnet is designed to extend downward, its end, *e*, being near the end, *g*, of the soft iron core of the electro-magnet. L represents a block of iron having the horizontal chamber, *h*, formed with an aperture at *k*. The end of this chamber is closed by means of a neatly fitting screw, *l*. A threaded perforation, *m*, extends to the chamber, *h*, at a distance from the aperture, *k*, and in this perforation is placed a governing screw, *n*. The point, *d*, of the arm of the steel magnet is designed to extend downward into the aperture, *k*, and in the chamber, *h*, is placed sufficient mercury to fill the horizontal portion of said chamber. The height of the surface of mercury in the aperture, *k*, is regulated by means of the screws, *l* and *n*, the latter being employed for the nice adjustment required. Adjustable stops, *s* and *t*, are employed to limit the movements of vibration of the steel magnet. N, N, represent binding posts for the wires, *z*, *z*, of a local battery. From one of these posts the local circuit extends by a brass standard, S, to the pivot bearings of the magnet, H, and when the point, *d*, of the magnet is in contact with the mercury the circuit extends through the magnet arm and mercury, and down by a brass standard, s^1, to the other binding post. When the point, *d*,

of the steel magnet is not in contact with the mercury the local circuit is open. In this relay, the polarity of the end, *g*, of the soft iron core of the electro-magnet is to be similar to that of the end, *e*, of the steel magnet, and therefore the binding posts, F, F, are to be so connected with the wire of the main line that the current passing through the coil of the electro-magnet shall produce in its core at *g* the same polarity as that of the steel magnet at *e*. The electro-magnet is to be adjusted by means of the thumb-screw, until the steel magnet is freely drawn by its own magnetism towards the end, *g*, of said core. This movement of the magnet, H, will lift its arm and move the point, *d*, out of connection with the mercury opening the local circuit. When the main circuit is closed, the end, *g*, of the core of the electro-magnet and the end, *e*, of the steel magnet having the same polarity, the end, *e*, will be driven by magnetic repulsion away from, *g*, vibrating the steel magnet outward, and bringing the point, *d*, of the magnet arm down into the mercury, and closing the local circuit. When, however, the main circuit is open, the end, *g*, of the core of the electro-magnet having no polarity, the magnetism of the steel magnet, H, will cause it to be drawn toward said end, *g*, thus lifting the point, *d*, from the mercury and opening the local circuit. The arm, K, of the steel magnet is not designed to be perfectly counterbalanced, but should have a slight excess of weight which is readily lifted by the permanent magnet, when the main circuit is open, and, when the current is introduced, this excess of weight assists the repulsive effort of the electro-magnet in throwing off the steel magnet.

CORRESPONDENCE.

Telephones.

With reference to the query of your correspondent in your last issue I understand that the "mechanic" receiver derives its name from having been originally described in the *English Mechanic*.

It comprises the combination of a parchment diaphragm with central iron button and an electro-magnet.

Certain improvements in its construction are, I believe, the subject of patents formerly the property of the London and Globe Company, and now in the hands of the United Telephone Company, but the original instrument having been disclaimed from Bell's patent is free for anyone to manufacture and use.

With reference to the carbon transmitter, according to Justice Fry's decision, the Edison patent was confined to a *tension regulator* in combination with a *diaphragm* or *tympanum*.

Hence it would appear that anyone may make a transmitter employing a carbon tension regulator so long as there is no diaphragm or tympanum in conjunction with it.

I should be obliged if any correspondent can inform me in what number of the *English Mechanic* the "mechanic" receiver is described, and I have no doubt that it would interest others besides myself to hear the opinion of some of your readers as to the truth of the above contentions.

S.

The so-called "mechanic receiver" with diaphragm of parchment or of gold-beater skin, was described in *Engineering*, in September, 1876, several months before date of Bell's patent—and consequently was public property—and it became necessary, to save Bell's patent, to disclaim it. For further particulars see page 435 of REVIEW, December 1, 1883.

From several decisions by the Courts it seems that telegraph wires can be erected over any public highway without permission from the authorities, provided they are not a nuisance or dangerous. There have been two decisions by the Courts that the use of carbon in a transmitter without a diaphragm is free to the public, see page 74 of REVIEW, July 28th, 1883. You will find in the judgment delivered by Lord M'Laren these words :—"Now, as Edison's patent is for a tension-regulator in combination wiih a diaphragm or tympanum, it follows that the interdict would not apply to the use of the respondent's *carbon* regulator without a tympanum."

Mr. Justice Fry decided that "the true meaning of the claim in Edison's patent is the union of a tympan or diaphragm capable of vibrating under sound waves, with a tension regulator, and that Edison described the essential requisite of his invention to be the combination of a vibrating diaphragm and a tension regulator."

There is no English patent in which can be found a claim to the use of carbon in a transmitter.

W. C. B.

London, *September 10th*.

What is Electricity?

[A few days since we were the recipients of the following strange communication, the name and address of the writer being withheld by us for obvious reasons.]

"I am very pleased to be able to inform you, and also all others that ever have taken an interest in that which is called 'Electricity,' that I am in a position to enlighten, or to give a true light on the subject ; that is to say, that I know exactly what electricity is ; in fact, I am also well acquainted with many and many of mysteries that are connected with the same, and yet are still unknown to all except to myself. But I shall be very pleased indeed if you, and also others, will take an interest in my supreme work of works by my explanation, and to show that electricity has been and is a mystery. And from me a great light shall shine upon all who undertake to work from me and with me, so as to enlighten many and many that are even now in total darkness. But I should like to explain the mysteries in writing, and also in my own style, as I am not, nor neither do I profess to be, an English scholar.

"An answer will greatly oblige.

"*September 6th*, 1884."

[To this we replied that if the writer would send any communication bearing upon the subject of electricity it should, if found suitable, find a place in our columns. If not likely to meet with the approval of our readers, the rejected MSS. would be, if desired, returned. In answer to our brief note we received the still more extraordinary effusion appended hereto.]

"I have received your letter and I thank you very much for your reply, but, plainly speaking, I am a poor man in pocket, therefore as poverty is at my door, although it is no disgrace to me, I say to you that I shall be thankful to you, and to all other electricians, if you will kindly support me, and by you so doing I am, and shall be the man that shall enlighten you and all others on the subject of electricity, as there is no other man in creation that can be I myself, but please understand from me that I am not building castles in the air, by saying that this world is worked with electricity, in fact I am able to see electricity by day and by night in its natural state, and working ; and I say that if justice is done to me I shall do the same to those who do the same to me, and willingly shall I do so, and I shall prove by my mysterious explanation that electricians are very great men.

"Now, gentlemen, not only on this world shall I speak, but on that which is above our heads as well, knowing that which I do know about that which is invisible, and which is quite natural to me, although I may appear to be very inferior to some people of this world, or in their estimation. But, gentlemen, all that I require is fair play and to be supported by kind friends, as I cannot live on wind and water ; and I shall prove that I am a man of men, and that I am the sole and only one that has found out what is electricity ; and my great knowledge I shall give freely, as all the money in creation, in one way of speaking, would not be sufficient to pay me for my supreme knowledge that I shall give for the benefit of one and all."

[As it is possible that this "man of men" might, if encouraged, gain his ends by working upon the credulity of enthusiasts, we have thought it desirable to give publicity to his communications. It strikes one as being somewhat odd that an individual knowing so much about electricity should concern himself with the fact that the two elements, "wind and water," will not support him. Does he not, in the depth of his wisdom, know that "electricity is life ?"—EDS. ELEC. REV.]